CARR FORK LAKE

KENTUCKY RIVER BASIN

KENTUCKY

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

PREPARED BY
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS

SEPTEMBER 1982

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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Site Geology	Compaction Test Results
Construction Notes	Shear Test Data
Foundation-Abutment Treatment	Seepage Control
Slope Stability	Operational Notes
Diversion-Closure	Instrumentation

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The embankment criteria and performance report provides a summary record of significant design data, design assumptions, design computations, specification requirements, construction equipment, construction procedures, construction experience, field control and record control test data and embankment performance as monitored by instrumentation during construction and during initial lake filling.

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Prepared By
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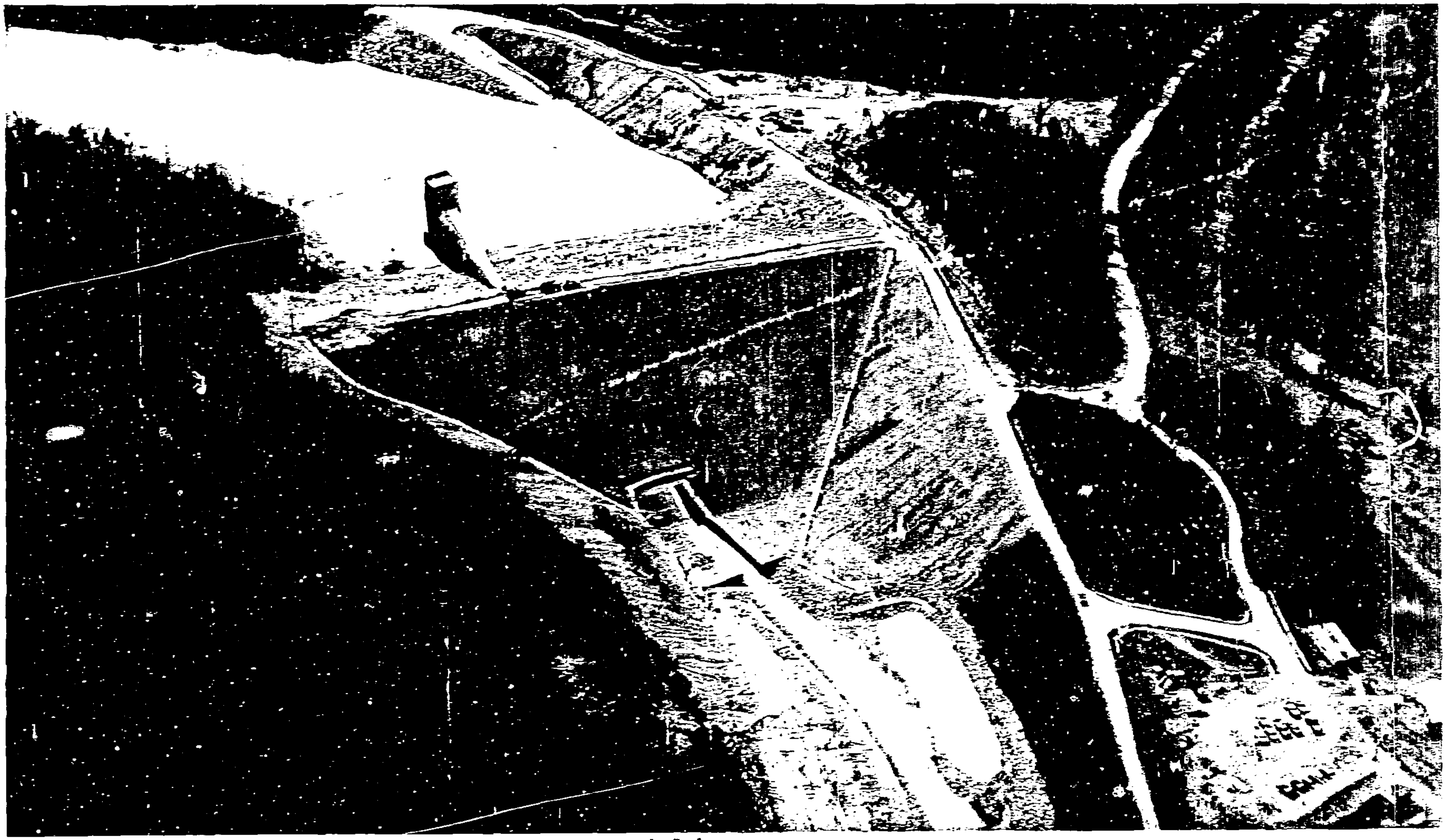

Aerial View of Carr Fork Lake

CARR FORK LAKE, KENTUCKY

EMBANKMENT CRITERIA AND PERFORMANCE REPORT

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Kentucky River Basin

Embankment Criteria and Performance Report

Pertinent Data

1. Authority for project. Flood Control Act designated as Public Law 87-874, approved on 23 October 1962, as recommended in House Document 423, 87th Congress.

2. Purpose of Project. To furnish flood protection in the valley of the North Fork of Kentucky River and the lower Kentucky River Basin. The reservoir project is a unit in the general comprehensive plan for flood control and allied purposes in the Ohio River Basin. A secondary purpose of the project is to provide storage for water supply, land water quality control and a pool for recreation and fish and wildlife activities.

3. Location of Project. The dam is located on Carr Fork, a branch of North Fork of Kentucky River about 8.8 miles above their confluence, near Vicco, Kentucky. It is located about 160 air miles southeast of Louisville, Kentucky and 150 miles south of Cincinnati, Ohio, in Knott County, Kentucky.

4. Drainage Area at Dam Site. 58 square miles.

5. Reservoir.

Item	Elevation (feet msl)	Area (Acres)	Storage: Acre Feet	Storage: Inches Runoff
Minimum Pool	1,009	530	11,830	3.81
Water Quality Pool	1,017	590	16,160	5.21
Seasonal Pool	1,027	710	22,640	7.29

Item	Elevation (feet msl)	Area (Acres)	Storage Acre Feet	Storage Inches Runoff
Flood Pool	1,055	1,120	47,700	15.38
Allocated to Flood Storage	1,017-1,055	-	31,540	10.17
Allocated to Seasonal Recreation	1,017-1,027	-	6,480	2.08
Allocated to Water Quality Control	1,009-1,017	-	4,330	1.40

6. Dam.

a. Embankment.

Type	Rock and Earth Fill
Top Elevation (msl)	1,083
Maximum Height, feet	132
Length, feet	753
Top Width, feet	30
Side Slopes - Upstream	1 on 2.5, down to elevation 1061
	1 on 3, down to elevation 992
	25.3-foot berm
	1 on 3, remainder
- Downstream	1 on 2.5

b. Spillway.

Type	Open Cut Through Left Abutment Ridge
Crest Elevation (msl)	1,055
Bottom Width, feet	265

Protection for Spillway Cut	Concrete sill at crest
Length, feet	574
Side Slopes	1 on 1.5 overburden (10-foot berms) 2 on 1 in rock

c. Outlet Works.

Conduit type	Circular, concrete
Conduit diameter, feet	8
Control gates, number	2 service, 2 emergency
Size of gates, feet	3.5 x 8
Invert elevation to outlet works	955
Discharge capacity with	
Seasonal Pool elev. 1,027, c.f.s.	2,060
Flood Pool elev. 1,055, c.f.s.	2,530

7. Land Acquisition

Fee, Acres	1,775

8. Relocations.

a. State Highways

Kentucky 15	6.3 miles
Kentucky 160	3.7 miles
Kentucky 582	0.2 miles
Kentucky 1410	0.2 miles

b. County Roads

Irishman Creek	3.3 miles
Defeated Creek - Kodak	5.5 miles
Smith Branch	0.6 mile
Trace Fork	0.2 mile

c. Public Utilities.

Electric, (Kentucky Power Co.)	Rc ocation	10 miles
	Abandonment	6 miles
Telephone, (Thacker & Grigsby Co.)	Relocation	21 miles
	Abandonment	5 miles

9. Public Access.

Number of Sites 4

10. Reservoir Clearing.

Area, acres 175

11. Hydroelectric Power. None

12. Annual Charges. $870,000

13. Annual Benefits.

a. Flood Control	$ 567,300
b. Water Quality Control	63,000
c. Recreation	316,000
d. Development	60,000
TOTAL	$1,006,300

14. Ratio, Benefits to Cost. 1.16 to 1

15. Construction Time. 3 1/2 years

Carr Fork Lake

Kentucky River Basin

Embankment Criteria and Performance Report

1. General.

a. Authority. Authority for preparation of the Embankment Criteria and Performance Report for Carr Fork Dam is contained in ER 1110-2-1901, dated 1 August 1972.

b. Project Purpose. To furnish flood protection in the valley of the North Fork of Kentucky River and the lower Kentucky River Basin. The reservoir project is a unit in the general comprehensive plan for flood control and allied purposes in the Ohio River Basin. A secondary purpose of the project is to provide a pool for recreation and fish and wildlife activities.

c. Project Location. The project is located on Carr Fork, a branch of North Fork of Kentucky River about 8.8 miles above their confluence, near Vicco, Kentucky. It is located about 160 miles southeast of Louisville, Kentucky and 150 miles south of Cincinnati, Ohio, in Knott County, Kentucky. The project location and vicinity map is shown on Plate 1. The general plans are shown on Plates 2 and 3.

d. History of Construction. The Outlet Works Contract DACW27-66-C-0050 for the construction of the operating tower, conduit, and stilling basin was awarded on 12 January 1966 to Markwell and Hartz, Inc. of Memphis, Tennessee and completed 31 January 1968. Contract DACW27-73-C-0009 for the construction of the dam and spillway was awarded to G.B. & Y., Inc. of London, Kentucky, on 23 July 1972 and completed on 30 November 1976.

SIGNIFICANT CONTRACT DATES

9 October 1972	Started clearing outlet channel and damsite.
16 April 1973	Grouting program initiated.
23 May 1973	Representatives of CD and ED visited site and decided insufficient weathered rock had been removed from the right abutment prior to grouting. Grouting on this abutment was stopped. Six exploratory core holes were drilled and some additional rock removed by presplitting. Some dental work was also performed.
19 June 1973	Began placing material in cofferdam "C".
12 July 1973	Stream diverted through the conduit.
13 July 1973	Grouting commenced again.
14 July 1973	Began fill for temporary U.S. channel cofferdam "A".
18 July 1973	Cofferdam "A" completed. Cofferdam "B" started.
21 July 1973	Temporary cofferdam "B" completed.
23 July 1973	Began excavating for permanent cofferdam.
29 July 1973	Temporary cofferdam "C" overtopped.
4 August 1973	Repairing flood damage to cofferdam "C".
14 August 1973	Started material placement for permanent cofferdam main embankment.

1 September 1973	Permanent cofferdam completed to elevation 992.
4 October 1973	Permanent cofferdam completed to elevation 1010.
11 October 1973	Began cleaning dam foundation D.S. of permanent cofferdam for main embankment.
22 October 1973	Began placing impervious core, transition stone, shale, and random fill in main embankment.
21 November 1973	Grouting at dam [illegible]ation completed.
5 December 1973	Placed 15 yards of [illegible]ental concrete over coal seam, Station 16+38 Centerline of dam.
10 January 1974	All work stopped for the winter.
1 April 1974	Contractor started placing fill in dam embankment again.
22 June 1974	Pool at elevation 988.2
14 March 1975	Pool at elevation 992.5.
11 April 1975	Impervious core topped out at elevation 1080.
23 April 1975	Dam embankment completed.
5 January 1976	Outlet works gates put into operation.
7 August 1976	Dedication of lake.
17 October 1976	Final Inspection of dam contract.

2. Geology.

a. Project Area. The Carr Fork Reservoir site is located in the Pottsville series of the Eastern Kentucky Geosyncline coal measures. The area is characterized by deep, steep-sided, narrow V-shaped valleys, with pockets or areas of clayey colluvium from old landsides that are usually found on the concave side of the valley wall. The sharp crested divides vary from elevation 1450 to 1950 and the valley bottom is about elevation 950. The formations encountered in the core drillings are typical of the Pottsville series, and the coal measures area, being composed of recurring strata of hard, fine grain sandstone, carbonaceous to silty to sandy shale, shaly sandstone, and thin to thick coal seams with variable thickness of sandy indurated underclays and silty, carbonaceous roof shales. The No. 4 or Fire Clay coal is about 5 feet thick and is the marker strata for this section. This coal is extensively mined throughout the reservoir area. The top of dam is elevation 1083 and the Fire Clay coal is at a minimum elevation of 1115. The Elkhorn coal seam, about 42 inches thick, lies about 50 feet below creek bottom at elevation 905 at the damsite. Structurally, the formations generally dip about 35 feet per mile west to northwest. The dominant joint patterns are N 10 E and S 83 W. Producing gas wells are present throughout the reservoir area. Some wells are in the flood plain of the main stream; others are in tributary drainage channels and on valley walls.

b. <u>Damsite</u>. There is considerable lithologic variation in the bedrock strata at the damsite. The bedrock from about elevation 1260 varies from a hard, gray, fine to medium grain, medium to massively bedded sandstone capping the narrow ridge at the spillway site, downward through some five or six hard, variably silty to sandy shale strata, and fine, massively bedded, occasionally shaly sandstone strata, to elevation 905. Scattered fairly uniformly throughout this approximately 350-foot bedrock section are some 12 to 14 thin mineable seams of bituminous coal. The Fire Clay coal marker strata is about elevation 1115$\pm$, and is mined commercially. Mining the 42-inch Elkhorn coal seam at the lower elevation is limited because excessive quantities of water are frequently encountered. The right valley bank at the damsite, elevation 955-965 is about 200 feet wide, and overburden thickness varies from 6 feet in the streambed to about 18 feet on the high right bank flood plain. Laboratory tests made on comparable material from correlative strata at Buckhorn Dam gave an unconfined compressive strength of 3,580 psi for silty, carbonaceous shale and 1,100 psi for clay shales, and the sandstone strata are much stronger than the carbonaceous shale. The deeper portions of the Carr Fork Reservoir embankment were founded on sandstone overlying silty, carbonaceous shale. The strength of the founding strata at this project is considered satisfactory for the imposed load. The geologic profile of the dam axis is shown on Plate 6. For reference, boring location plans are presented on Plates 4 and 5.

c. Abutments. The abutments below the top of dam encompass two massive sandstone strata separated by a 60-foot thick silty to sandy shale stratum containing three thin coal seams. This coal is not mined commercially. The right abutment has a slope of about 2.25 horizontal to 1 vertical. Few bedrock outcrops are present. The thin Little Fire Clay coal seam, about 1.9 feet thick, occurs at about elevation 1092, some 9 feet above top of dam. Overburden thickness varies from zero at the sandstone outcrops to about 18 feet near the toe of the slope. The overburden soil is a sandy to silty clay with rock fragments. Primary weathering of bedrock is deeper in the thin bedded shale and shaly sandstone strata than in the more massive sandstone. It varies from 1 to 7 feet and averages about 2 feet in thickness in the sandstone and about 4 foot in the other strata. Bedrock is relatively watertight below elevation 985. Groundwater surface in the right abutment holes varies from a low elevation of 965 to a high elevation of 1055. The left abutment slope is steeper than that of the right abutment, being about 1.5 horizontal to 1 vertical. The slope has numerous sandstone outcrops. The thin Little Fire Clay coal outcrops at about elevation 1084 on this abutment. Overburden thickness varies from zero at the bedrock outcrops to about 15 feet in the area of old landslides and between Kentucky Highway 15 and the toe of the slope. The thin veneer of rocky, silty clay cover in the dam foundation and uphill from the road cut at station 1+20 varies from zero in thickness to 5 feet in the clay shale and coal zones. The material from the road excavation, spoiled downslope, averaged 8 to 12 feet in thickness. This spoil contained large size rock pieces. Primary weathering in bedrock averages about 2 feet. Groundwater varies from a low elevation of 952 to a high elevation of 1063.

d. Spillway. The spillway is located on the narrow left abutment ridge some 200 feet upstream from station 0+00 of the dam. It has a width of 265 feet at crest elevation 1055, and a top width of about 460 feet. The spillway cut at the center is about 574 feet long. Ground surface at the left bank is elevation 1266 and at the right bank it is elevation 1174. The formations encountered in excavation of the spillway are typical of the area. Beginning in a sandstone at top, there are 7 medium thick to thick sandstone strata, 5 medium thick shale strata, and 6 coal seams. The commercially mineable Fire Clay coal is about elevation 1120. An abandoned opening into this coal is nearby upstream from the spillway site. The extent of mine operations in the area is not known; however, 5 mine rooms were encountered on the left side of the spillway. The sandstones and silty shale strata are well cemented. As evidenced by nearby highway excavation, the sandstone broke out in rather large pieces unless shot rather heavily. Pre-splitting was required. A concrete control structure was used. The strength and weathering characteristics of the series are satisfactory for the construction of the 200-foot deep cut. Side cuts of 4 vertical on 1 horizontal were used except for the predominantly shale sections on the left side of the spillway between elevations 1055 and 1120 and 1222-1262. These were cut to 2 vertical on 1 horizontal. Ten-foot wide berms were located at the base of the sandstone stratas below this elevation.

3. <u>Foundation and Abutment Treatment</u>. The core trench was stripped to solid rock first on both abutments so that the foundation grouting could be started. The foundation grouting program started on the right abutment. A double line grout curtain was initiated between stations 14+25 and 18+20; however, it was determined that the abutments within the core trench were not adequately stripped to unweathered rock or clean enough for grouting. All grouting efforts were ceased until the core area was cleaned. All grout holes were drilled with CP-65 air rotary collar or air track drills using EX diameter diamond plug bits. No sand or fly ash was used in the grouting on this project. A double line grout curtain was placed from station 10+35 to station 18+20. The split-space method was used when a hole took over 5 sacks of cement per zone or stage. In these cases, holes were split to a spacing of 2.5 feet to assure a tight foundation. Grout holes were drilled on 20^{o} angles, into the abutments, except the angle was changed to get better coverage under the conduit. A normal, tight hole was drilled and grouted in two zones. The first zone drilling on the abutments was 20 feet deep and in the valley bottom 10 feet deep. The first zone grouting was done to cap off the upper layers of the foundation so that the second zone could be grouted at higher pressures to assure a tight foundation. Staging was done to the grout holes in two cases. If there was an appreciable amount of drill water loss, the hole was staged (stopped early), pressure tested and grouted before drilling to further depths. The other condition was when artesian flow was encountered. The drilling was stopped, artesian pressure measured, pressure tested, then grouted before drilling to further depths.

There were very few problems encountered during grouting. There were various joints encountered within the core trench in the embankment foundation and on the left abutment. These joints were cleaned out to a depth 3 times their width. They were then filled with a special non-shrinking, quick setting grout. There were seven coal beds exposed in the core trench. All of these received dental treatment, either concrete or mortar. On the left abutment, there were four coal beds; one at elevation 980.0 to 980.3, cleaned out 1 foot in depth and filled with mortar the width of the core trench; two at elevation 1025.3 to 1026.3 and 1027.5 to 1028.0 with a shale layer between them. These two coal beds were cleaned out altogether, along with the shale layer, the width of the core trench, 1-foot deep, and filled with concrete. One coal seam at elevation 1056.7 to 1056.9 along with 0.7 foot of underclay was cleaned out 1 foot in depth and filled with concrete. On the right abutment there were three coal seams; one at elevation 988.5 to 988.7 cleaned out, 1-foot deep, the width of the core trench, and filled with mortar; two beds from elevation 1048.1 to 1049.6 with a shale layer between them from 1048.5 to 1049.2 were cleaned out the width of the core trench, 1-foot deep and filled with concrete. During an optional 50-foot widening of the left wall of the spillway to obtain more rock for the embankment construction, 5 mine rooms were encountered during presplitting operations. These rooms are in the Hazard #4 coal seam from elevation 1120 to 1124. These openings were sealed with concrete to prevent any further deterioration, and to prevent entry by visitors. 1415 cubic yards of concrete was used. The foundation treatment is shown on Plate 8.

4. Embankment.

a. General. The embankment section utilized the suitable required excavation from construction and borrow from the designated areas in the upstream valley and the left abutment. The embankment was constructed to elevation 1083 for a maximum height of 132 feet above bedrock. Crest width is 30 feet. The length of the dam is 753 feet at the crown. The structure is arched upstream on about a one degree curve. The upstream slopes are 1 on 2.5 down to elevation 1061 then 1 on 3 down to elevation 992, a 25.3 foot berm and then 1 on 3 down to the toe. The downstream slopes are 2.5 to 1. The dam is constructed on bedrock with a central impervious core and random earth and rock fill shells. The core is symmetrical with slopes of 1 horizontal to 8 vertical. The random material was obtained from the spillway excavation. A 10-foot horizontal thickness of graded transition material was placed between the shale and impervious fills on the upstream section and between the impervious and shale fills and impervious and random earth fills on the downstream section. The area under the impervious core required special foundation treatment consisting of removal of any soft and weathered rock to be accomplished before grouting began. Select material from the spillway excavation was placed to a minimum normal thickness of 10 feet on the upstream slope to provide protection against wavewash. This protection is provided from top of embankment to elevation 1004 (5 feet below minimum pool). Shale fill a minimum normal thickness of 10 feet was provided on the downstream slope down to elevation 1012. The random rock fill was placed in lifts not to exceed 2 feet in thickness and was compacted by 4 passes of a 50-ton rubber tired roller. The coarse material was bladed toward the outer slope and the fines were bladed against the shale fill. The impervious fill was compacted by 6 passes over each 6-inch lift with a sheeps foot roller. At least 95 percent standard density was obtained by this method. The coal seams in the left abutment under the embankment required special treatment. This consisted of cleaning the coal and soft shale out of the abutment face for a distance of about a foot and refilling with concrete or mortar. A 12-foot horizontal thickness of shale was placed between the transition zones and the random earth and rock fills. This material was obtained from the spillway excavation and compacted with a self propelled Caterpillar 825B. The lifts did not exceed 12 inches in thickness and the number of passes was two. The site plans and typical dam sections are shown on Plates 9 through 11.

b. Material Sources. Approximately 946,000 cubic yards of earth and random fill, drainage and transition material and protection stone was required in the dam section. The material used to construct the primary embankment zones is presented below.

Impervious

Designation	Source
Storage "A"	Stockpile from relocation at Highway 15.
D.S. Storage	Stockpile from stripping of dam area.
Borrow "A"	Upstream right descending valley.

Area "OA" — Upstream left descending valley.

Rock

Spillway Excavation

Upstream Rock Borrow — Upstream right descending valley.

The Materials Usage Charts are shown on Plates 12 an 13.

c. Compaction Equipment. The following rollers were used in compacting the embankment materials:

Sheepsfoot Rollers.

a. Ferguson Model #22-MOD

b. Towed

c. Drums: Number - 2, diameter - 5 ft., length - 6 ft.

d. Tamping foot

1. Base area - 7.5 $in.^2$

2. Shape - Trapezoidal with rectangular cross section.

3. Length - 9.5 in.

4. Number/drum - 144

5. Number/row - 18

6. Number rows - 8

e. Roller weight

1. Empty - 26,850 lbs.

2. As used - 50,000 lbs.

f. Foot pressure - 417 psi

g. Cleaners and frame

1. Teeth on frame between feet

2. Rigid frame

h. Speed of travel during compaction

1. Specified - 5 mph max.

2. Actual - 4 mph

<u>Vibratory Rollers.</u>

a. Raygo Rascals Dynamic 400

b. Self propelled

c. Drum

1. Number - 1

2. Diameter - 59 in.

3. Length - 84 in.

d. Static roller weight - 17,900 lbs.

e. Dynamic pressure - 27,000 lbs.

f. Vibrating frequency - 1100 to 1500 VPM

<u>Pneumatic - Tired Rollers.</u>

a. W. E. Grace Mfg. Co. Model Y-18

b. Tires

1. Number - 4

2. Size - 18.00X25

3. Ply rating - 32

4. Spacing - 10.5 in.

c. Roller width, weight, and tire pressure

1. Width - 93"

2. Weight: As used - 70 tons.

3. Tire pressure - 90 to 100 psi

d. Contact pressure - 100 psi

e. Speed of travel

1. Specified - 5 mph; max.

2. Actual 4 - 5 mph

Tamping Rollers.

a. Caterpillar 825B

b. Self propelled

c. Drum

1. Number - 4

2. Diameter - 51 in.

3. Length - 44.5 in.

d. Tamping foot

1. Base Area - 29.75 $in.^2$

2. Length - 7.5 in.

3. Number/wheel - 65

4. Number [illegible] - 13

5. Numb[illegible]ows - 5

e. Roller [illegible]ght

1. As used - 67,760 lbs.

f. Foot Pressure - 114 psi

d. Materials Placement.

(1) Impervious Zone. The impervious fill consisted of SC and SC-SM materials. The material was spread in 8-inch loose lifts where the sheepsfoot roller was used and 4-inch loose lifts in areas inaccessible to the towed sheepsfoot roller and compacted by a mechanical hand tamper. Six passes of the sheepsfoot roller and 3 with the hand compactor were used to obtain compaction. The moisture content permitted by the specifications was between plus or minus 2 percentage points of optimum. However, it was found that some material could not be placed without deformation with moisture content approaching plus 2 percentage points of optimum. Some material placed with a moisture content of between plus one and two percentage points of optimum had to be removed, aerated, and placed again.

(2) Transition Zone. The material for this zone consisted of crushed limestone obtained from a commercial quarry. This material was spread in 12-inch loose lifts and compacted by four complete passes with a Raygo Rascal Dynamic 400 vibratory roller. No moisture control was required on the graded aggregate zones.

(3) Shale Fill. The shale was spread in 12-inch loose lifts. These zones were compacted by two passes with a 825B Caterpillar tamping roller. The shale was placed at the natural moisture content.

(4) Random Fill. This material consisted of sandstone and shale spread in 24-inch lifts. The random fill zone was compacted by 4 complete passes of a pneumatic-tired roller.

(5) Random Earth Fill. The specifications called for this material to be spread in 12-inch lifts and compacted by 4 complete passes of a rubber tired roller. However, the Contractor requested to place this material in 8-inch lifts and roll with a sheepsfoot roller and this method was permitted. The upper limit of moisture control was 3 percentage points above optimum.

The distribution of density tests performed on the impervious material, transition material, shale fill, random fill and random earth fill are shown on Plates 14 through 18. A summary of field compaction control test data and design placement requirements for the dam is shown on Plate 19. The laboratory compaction proctor curves are shown on Plates 20 and 21.

e. Seepage Control. To insure water tightness at the foundation, a double line grout curtain was constructed along the centerline of the dam. Design seepage computations through the impervious zone were based upon a permeability coefficient of 0.015×10^{-4} feet per minute based upon test of composite samples from the borrow areas. Seepage was computed for the seasonal pool at elevation 1027 for an extended length of time. Based on the design and the low permeability of the soil, seepage through the dam is not considered a problem.

To prevent migration of the impervious materials from the core zone, a 10-foot wide transition zone was constructed on both upstream and downstream sides of the core. The material was reasonably well graded between the following limits.

Sieve Size	%Passing Prior to July 1974	%Passing After July 1974
2-1/2"	100	100
2"	90-100	90-100
1"	65-85	65-100
3/8"	35-65	35-75
#4	25-55	20-60

Sieve Size	% Passing Prior to July 1974	% Passing After July 1974
#40	10-25	5-25
#200	0-10	0-10

f. Shear Strengths. Because of the low "Q" shear strength and high organic content of the foundation overburden materials, it was determined that these materials were to be removed. The "R" strengths for the impervious borrow material was adopted on a weakest material concept. The "S" strengths for the impervious materials were all essentially the same; therefore, the adopted value is based on a numerical average of the shear test values. Optimum plus 2 percent is considered a realistic design moisture content. A plot of shear strength versus percent wet of optimum was made to determne "Q" shear strength. The shear strengths of the random material were based on a limited number of tests. The adequacy of these shear strengths was confirmed with subsequent testing at other projects.

TABLE 1

Material	γ_d lb/ft^3	γ_m lb/ft^3	γ_s lb/ft^3	γ_b lb/ft^3	Shear Values Test	Tanϕ	C T/FT^2
Impervious	110.2	125.0	131.0	65.0	Q	0.00	0.70
					R	0.43	0.20
					S	0.60	0.00
Random	110.2	135.0	140.0	77.5	Q	0.65	0.00
					R	0.29	1.20
					S	0.65	0.00

The composites used to determine the adopted soil design values are shown on Plates 37 through 41.

g. Stability Analyses. The embankment section has been subjected to analysis by the sliding wedge and block method. The adopted shear test values were used in analysis. The methods used in the analysis follow the procedures outlined in Appendix IV, EM 1110-2-1902. The slopes were analyzed for end of construction, steady seepage, partial pool and sudden drawdown. Since the damsite is not located in an area of seismic activity, no earthquake analysis was considered. Cases studied along with values obtained are presented below:

Table 2

Case	Slope	Minimum Safety Factor	Required Safety Factor
End of Construction	U.S.	2.27	1.30
End of Construction	D.S.	1.81	1.30
Sudden Drawdown (Maximum Pool)	U.S.	1.92	1.00
Sudden Drawdown (Spillway Crest)	U.S.	1.80	1.20
Partial Pool	U.S.	2.24	1.50
Steady Seepage	D.S.	1.87	1.50

It was not considered necessary to reanalyze the cases studied under the original analysis because of the type of changes made during preparation of the contract plans. The embankment was rezoned slightly and the top of dam was raised 2 feet. The stability analyses are shown on Plates 22 through 27.

5. <u>Diversion and Closure</u>.

a. <u>Diversion</u>. The sequence of construction is shown on Plate 7. Due to the late contract award of 25 July 1972, only clearing of the outlet channel and damsite was accomplished during the 1972 season. Cofferdam construction was initiated with cofferdam "C" around the control tower excavation which later became a part of the permanent embankment. Diversion through the outlet works was accomplished on 12 July 1973 by constructing a small dike across the upstream channel. The outlet works conduit was constructed, in an open cut, of reinforced concrete in 20-foot monoliths. In the impervious zone of the dam, lean concrete fill was placed on each side of the conduit to the top of the extrados. Three seep rings were placed around the conduit in this area. Beyond the impervious zones, compacted earth fill was placed to the top of the conduit or to the top of rock. Cut slopes are 4 on 1 in rock and 1 on 1.5 in earth. Then temporary cofferdams "A" in the upstream channel area and "B" in the downstream channel area were constructed by dragline excavation of a minimum 4-foot wide cutoff trench to the gray shale bedrock and backfilled to original ground by placing impervious fill. Design top elevation at temporary cofferdam "A" was 970 and temporary cofferdam "B" was 960. The temporary cofferdams were completed by 21 July 1973. On 23 July 1973 the excavation for the main embankment in the area of the permanent cofferdam was initiated. On 29 July 1973, cofferdam "C" was overtopped and cofferdam "B" was breached to prevent possible failure and a wall of water being released downstream. The cofferdams were repaired after the water subsided.

b. Permanent Cofferdam. The excavation for the permanent cofferdam was initiated on 23 July 1973, and permanent cofferdam embankment placement was initiated on 14 August 1973. By 1 September 1973, the permanent cofferdam was completed to the designed elevation of 992. Placement continued in the permanent cofferdam to elevation 1010 by 15 September 1973. On 11 October 1973, the cleanup of the dam foundation downstream of the permanent cofferdam was initiated and impervious core placement was initiated on 22 October 1973.

6. Changes in Design and Modifications.

a. Revised Spillway Width. Subsequent to award of the contract, a recomputation of quantities was made and it was determined that construction of the dam embankment with excavation of the spillway as indicated by the contract drawings would result in a rock shortage of approximately 37,000 cubic yards. In addition, weather conditions delayed planned construction progress to the point where it was deemed necessary to utilize some of the fill (shale and sandstone from the spillway) in the random earth zone. This utilized rock from the spillway resulted in a further shortage of 13,000 cubic yards.

The top area of the embankment above elevation 1030 and downstream of the random fill was to be constructed of Random Earth or Random Fill. The Random Earth was to be obtained from designated areas upstream of dam if suitable at the time of need. However, the areas were subject to inundation and the suitability of the material could not be determined until the time of need. Therefore, it was determined that 30,000 cubic yards of additional rock should be provided in the planned spillway widening as an alternate source for this zone if found to be required. Therefore, the spillway was widened 50 feet along the left side from the beginning of the cut to provide a total of 80,000 additional yards of rock from the spillway.

b. Revised Gradation of Graded Aggregate. Subsequent to the award of the contract and after placing 19,270 cubic vards of transition material, it became evident that the sole supplier of Graded Aggregate for use in the transition zone could not consistantly meet the gradation requirements of the contract. Review of the gradation requirements showed that the gradation could be liberalized and still retain its function. Therefore, it was deemed necessary and in the best interest of the Government to modify the contract specifications with a revised gradation for graded aggregate to prevent delays with the embankment and future impoundment. The revised gradation is shown under Seepage Control.

c. Rezoning of Dam Embankment. As the dam neared completion it was determined that sufficient rock was not available from the contract sources and the Contractor was directed as a change order to use random earth fill in lieu of the option of using random earth or random fill (rock). This revision made the following changes:

1. Eliminated shale and transition zones on upstream side at elevation 1038.

2. Continued graded aggregate transition zone to elevation 1055 on downstream side.

3. Eliminated shale zone on downstream side at approximate elevation 1030.

4. Use random earth to bring the downstream side up in the area of the existing bench at elevation 1012.

5. Use a 10-foot wide shale zone on downstream edge of fill slope.

6. Use a 10-foot wide shale layer back of the sandstone facing on the upstream face.

After proceeding with the random earth fill to elevation 1046 the embankment placement was stopped due to pumping and heaving, as a result of excessive moisture, on 20 September 1974. Investigation resulted in cancelling the previous change order to use random earth fill because the random earth fill was found to be unsatisfactory. About 5 feet of the random earth embankment was removed from the upstream side down to stable material. The specifications allowed for the placement of this material with up to plus 3 percent moisture of optimum and there was an abnormal amount of rain for this time of the year. At this time, it was decided to investigate an additional rock borrow area.

On 24 September, it was decided to go back to the original design with the shale zones, graded aggregate zones, with random rock on the upstream side and random earth on the downstream side with a 12-foot wide zone of shale on outside face of the downstream slope. The necessary rock to complete the embankment was obtained from a rock borrow upstream of the dam on the right descending side of the valley.

7. Instrumentation.

a. General. No instrumentation was installed or monitored during construction of the embankment. After the embankment was topped out four Casagrande type piezometers were installed in the impervious core with lines of movement monuments installed on the crest and midway on the upstream and downstream slopes. As a result of the periodic inspections, two wellpoint piezometers were installed near the downstream toe of the embankment prior to impoundment. Instrumentation plans, details and sections are shown on Plates 28 and 29.

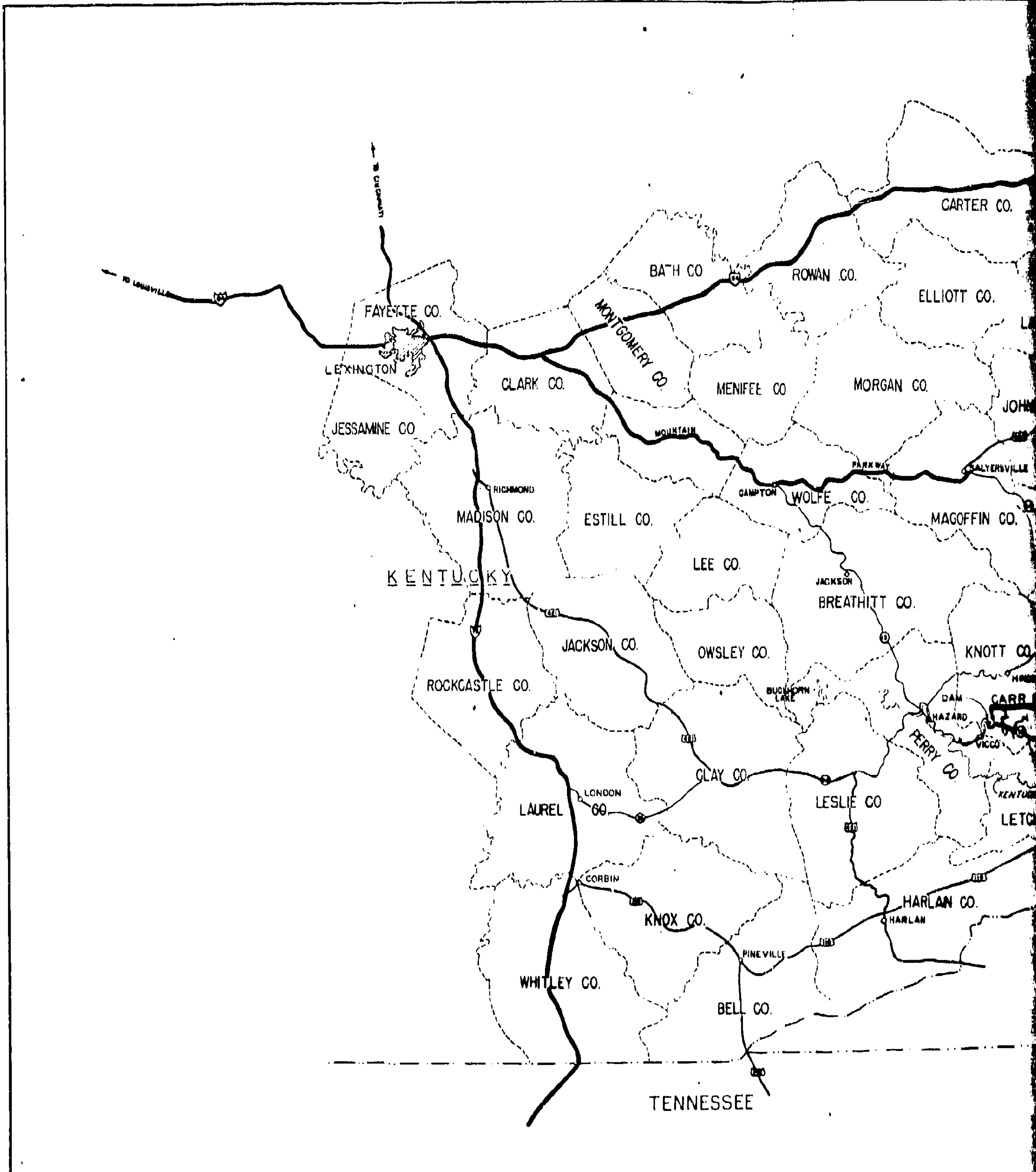
b. Piezometers. The piezometers located near the upstream face of the impervious core react almost directly with the pool while the piezometers located near the downstream face show a significant drop. These piezometers indicate the expected seepage line through the impervious core and confirm the effectiveness of the core. The wellpoint piezometers located near the downstream toe of the embankment indicate that the random rock fill is free draining with no pore pressure buildup at the downstream toe. Instrumentation readings taken to date do not indicate any excessive piezometric conditions. The piezometer plot is shown on Plate 30.

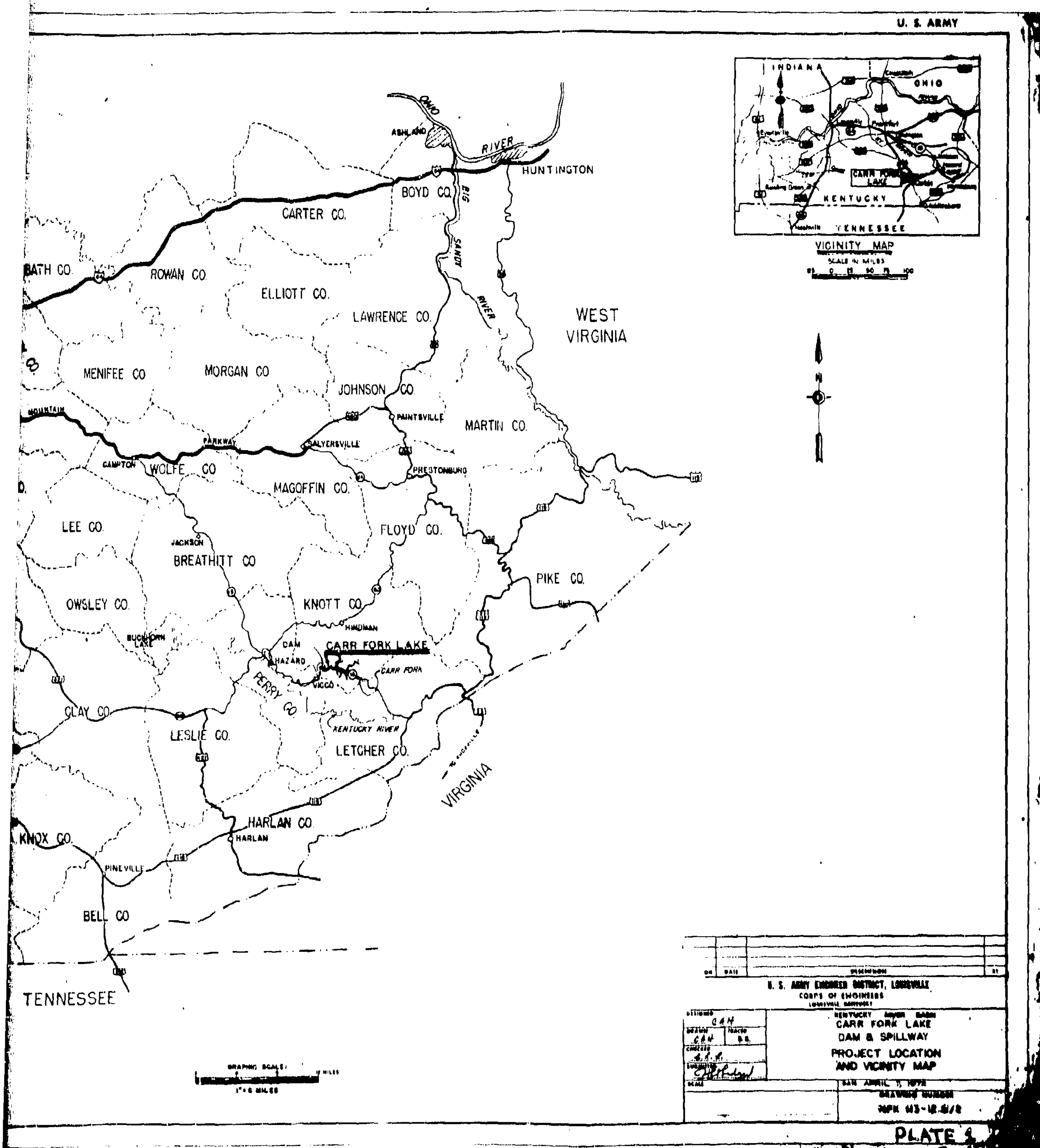
c. Movement Markers. Movement monuments on the slope were installed prior to impoundment while the line across the crest was installed during the initial filling of the lake. Instrumentation readings taken to date do not indicate any significant movement of the embankment.

The horizontal and vertical movement plots are shown on Plates 31 through 36.

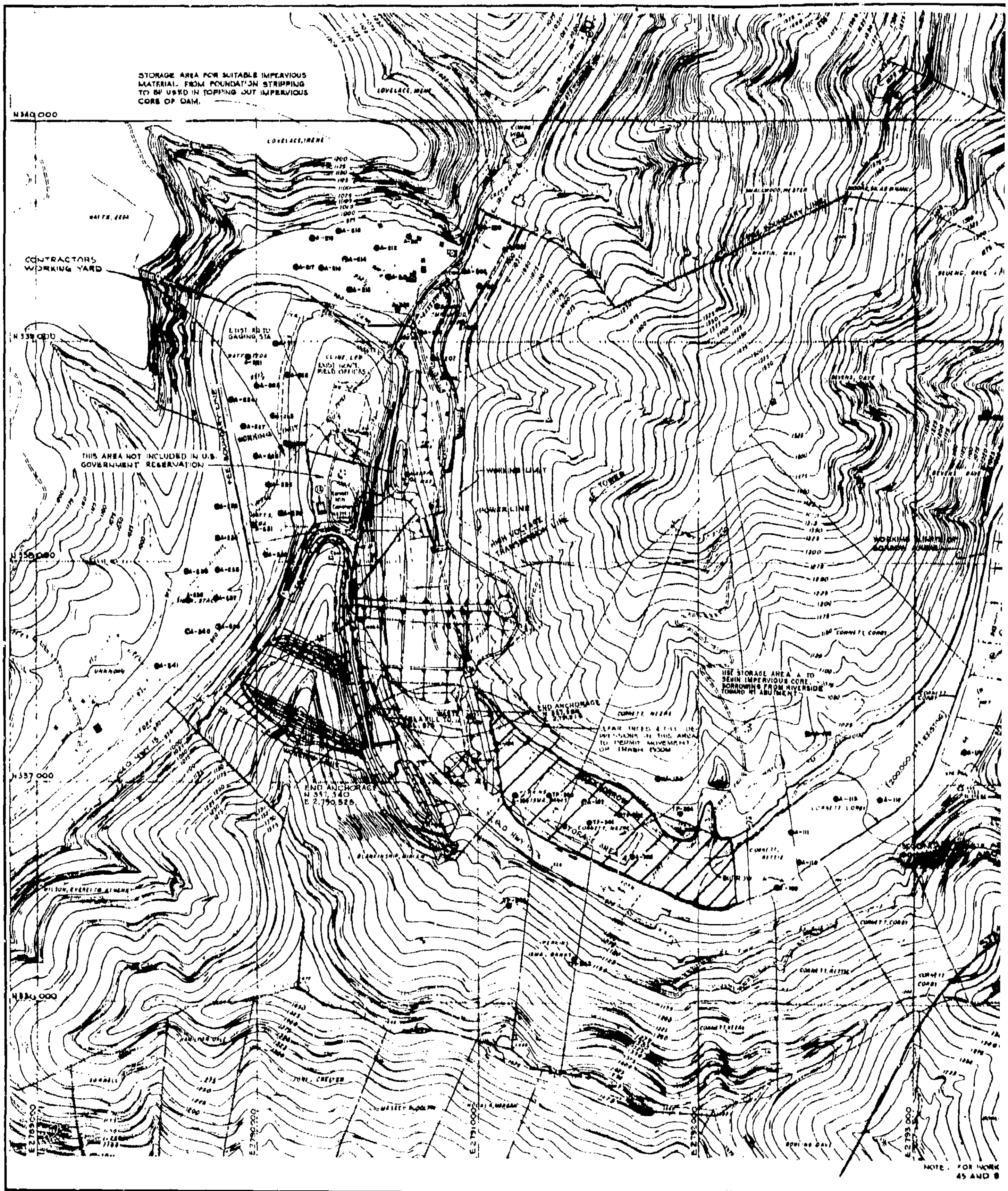
d. Service Bridge Monumentation The movement markers installed on the service bridge have been monitored and do not indicate any significant movement.

CORPS OF ENGINEERS




U. S. ARMY
INDIANA
OHIO
KENTUCKY
TENNESSEE
CARR FORK LAKE
VICINITY MAP
SCALE IN MILES
OHIO
ASHLAND
RIVER
HUNTINGTON
BOYD CO.
BIG SANDY RIVER
CARTER CO.
BATH CO.
ROWAN CO.
ELLIOTT CO.
LAWRENCE CO.
WEST VIRGINIA
MENIFEE CO.
MORGAN CO.
JOHNSON CO.
PAINTSVILLE
MARTIN CO.
MOUNTAIN PARKWAY
SALYERSVILLE
CAMPTON
WOLFE CO.
PRESTONBURG
MAGOFFIN CO.
LEE CO.
FLOYD CO.
JACKSON
BREATHITT CO.
PIKE CO.
OWSLEY CO.
KNOTT CO.
HINDMAN
BUCKHORN LAKE
DAM
CARR FORK LAKE
HAZARD
CARR FORK
VICCO
PERRY CO.
CLAY CO.
LESLIE CO.
KENTUCKY RIVER
LETCHER CO.
VIRGINIA
HARLAN CO.
HARLAN
KNOX CO.
PINEVILLE
BELL CO.
TENNESSEE
GRAPHIC SCALE
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY
CARR FORK LAKE
DAM & SPILLWAY
PROJECT LOCATION
AND VICINITY MAP
PLATE 2

CORPS OF ENGINEERS



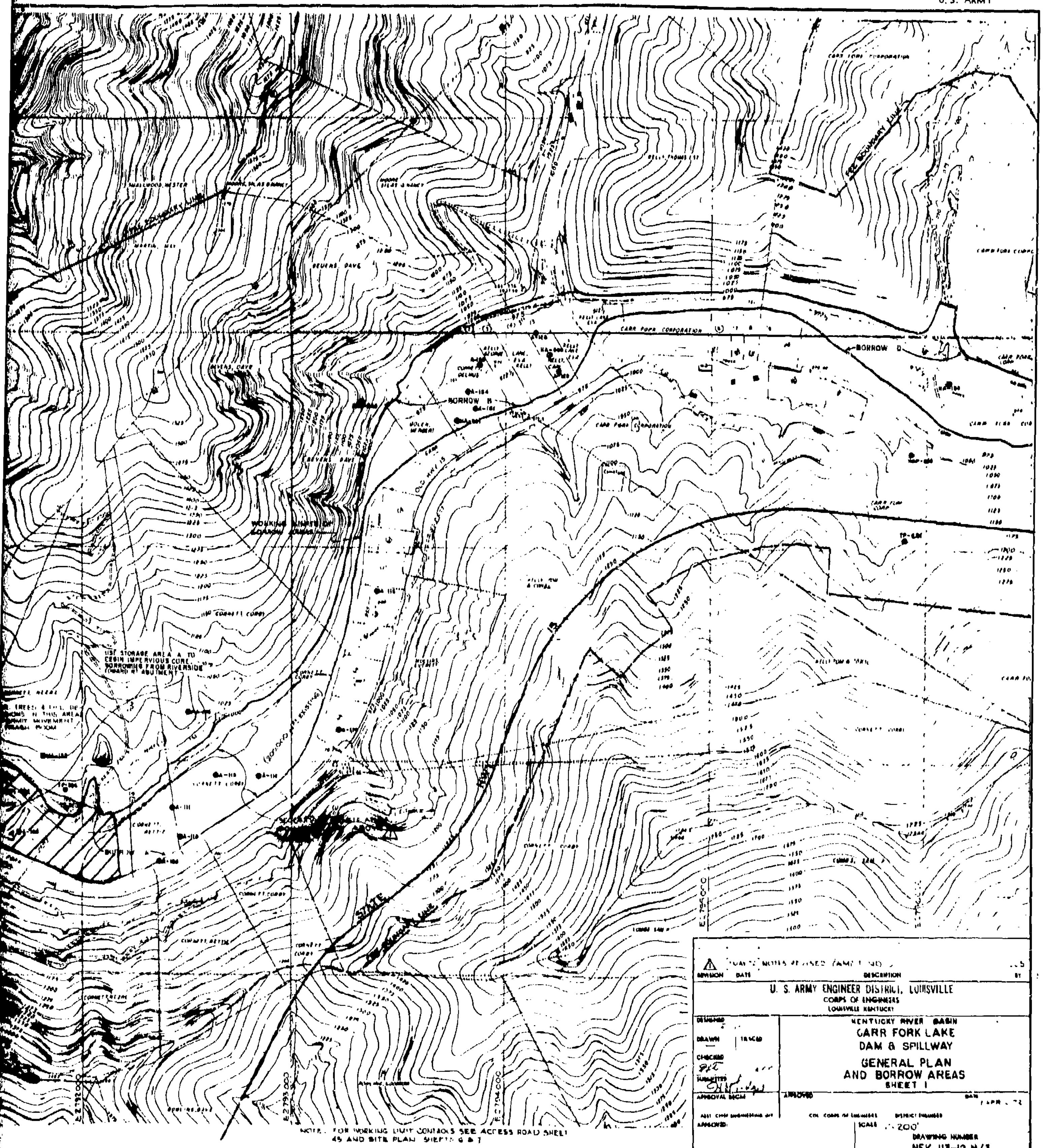
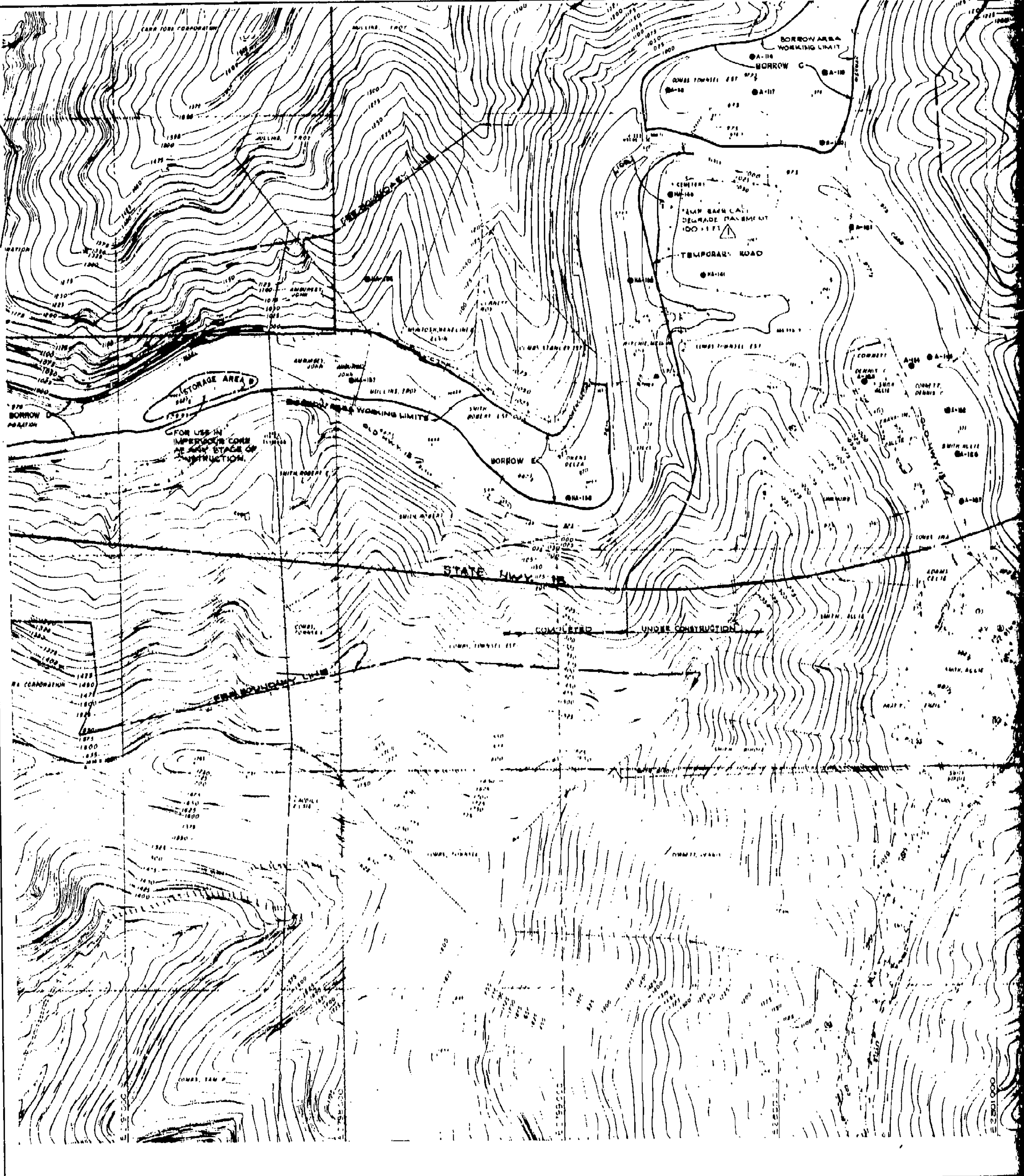
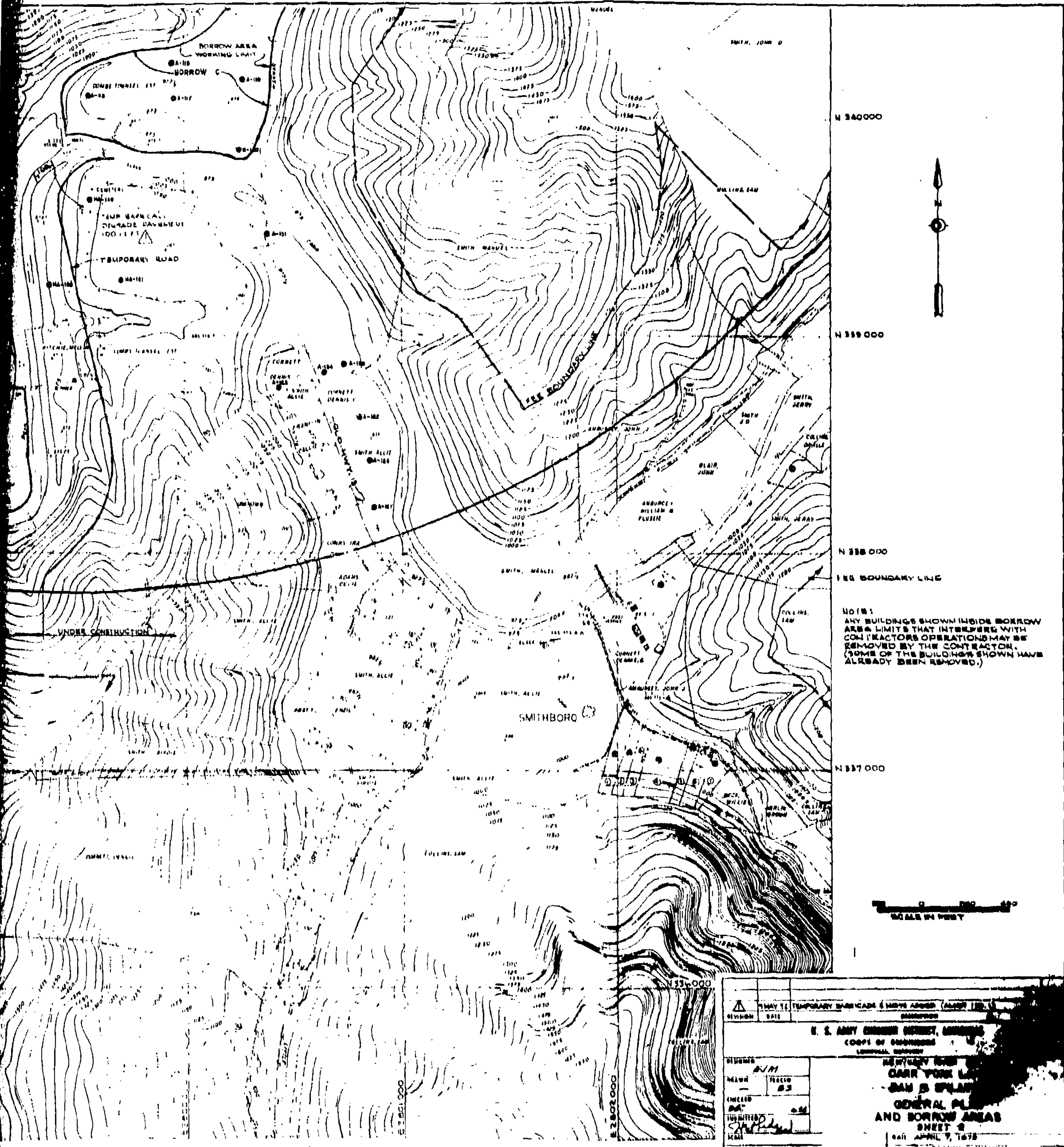

U. S. ARMY
BORROW B
BORROW D
CARR FORK CORPORATION
WORKING LIMITS OF BORROW AREAS
USE STORAGE AREA A TO OBTAIN IMPERVIOUS CORE. BORROWING FROM RIVERSIDE TOWARD RT ABUTMENT
STATE
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE KENTUCKY
KENTUCKY RIVER BASIN
CARR FORK LAKE
DAM & SPILLWAY
GENERAL PLAN
AND BORROW AREAS
SHEET 1
DRAWING NUMBER
NFK 113-12.8/3
NOTE: FOR WORKING LIMIT CONTROLS SEE ACCESS ROAD SHEET 45 AND SITE PLAN SHEETS 6 & 7

PLATE 2


MATCH LINE SEE SH. 3
BORROW AREA WORKING LIMIT
BORROW C
TEMPORARY ROAD
STORAGE AREA B
FOR USE IN IMPERVIOUS CORE AT ANY STAGE OF CONSTRUCTION
BORROW AREA WORKING LIMITS
BORROW D
BORROW E
STATE HWY. 15
COMPLETED
UNDER CONSTRUCTION



NOTES:
ANY BUILDINGS SHOWN INSIDE BORROW AREA LIMITS THAT INTERFERE WITH CONTRACTORS OPERATIONS MAY BE REMOVED BY THE CONTRACTOR. (SOME OF THE BUILDINGS SHOWN HAVE ALREADY BEEN REMOVED.)

GENERAL PL
AND BORROW AREAS
SHEET 2
DATE APRIL 7, 1975
DRAWING NUMBER
NFK 13-12.8/4

PLATE 3

CORPS OF ENGINEERS

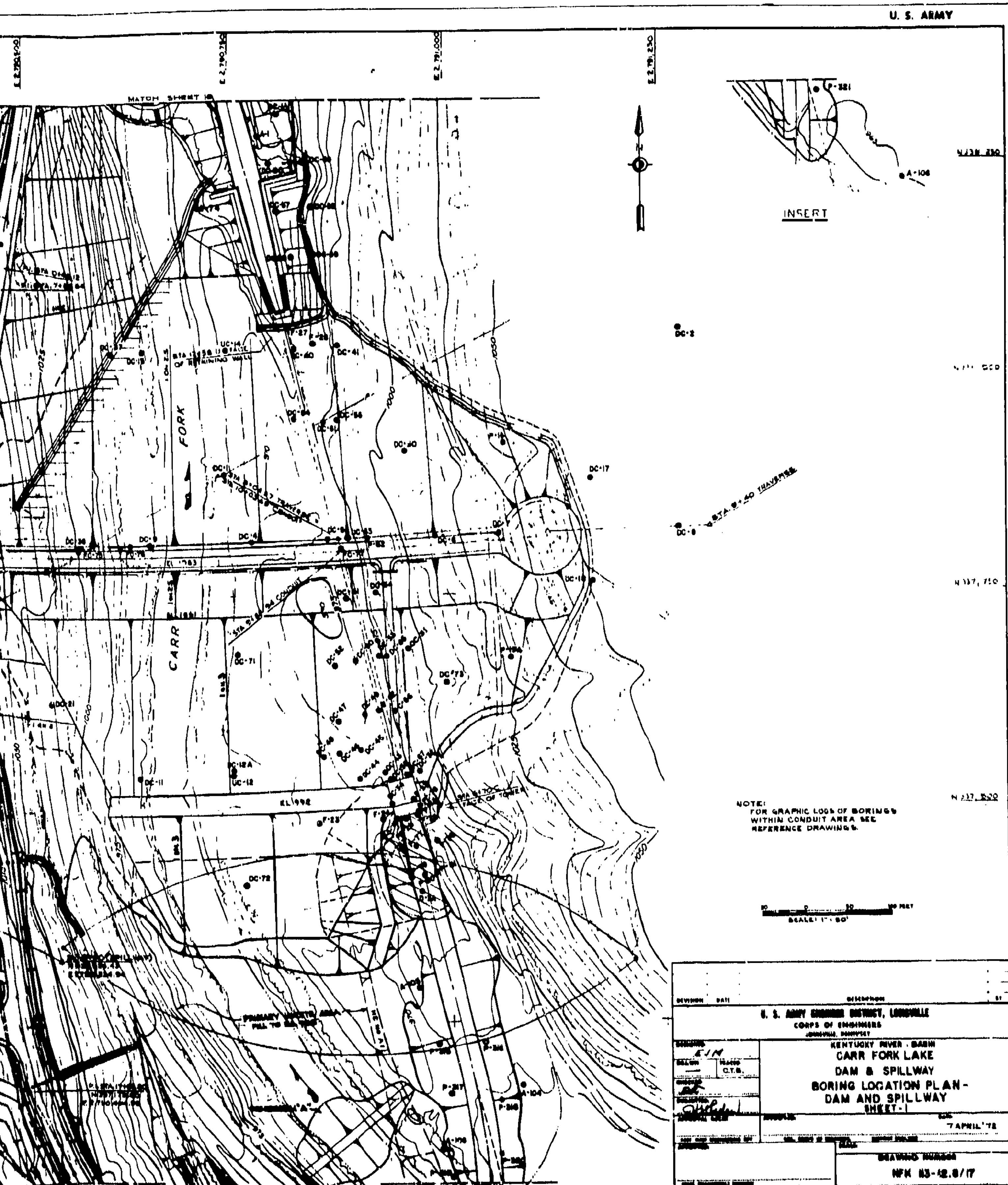
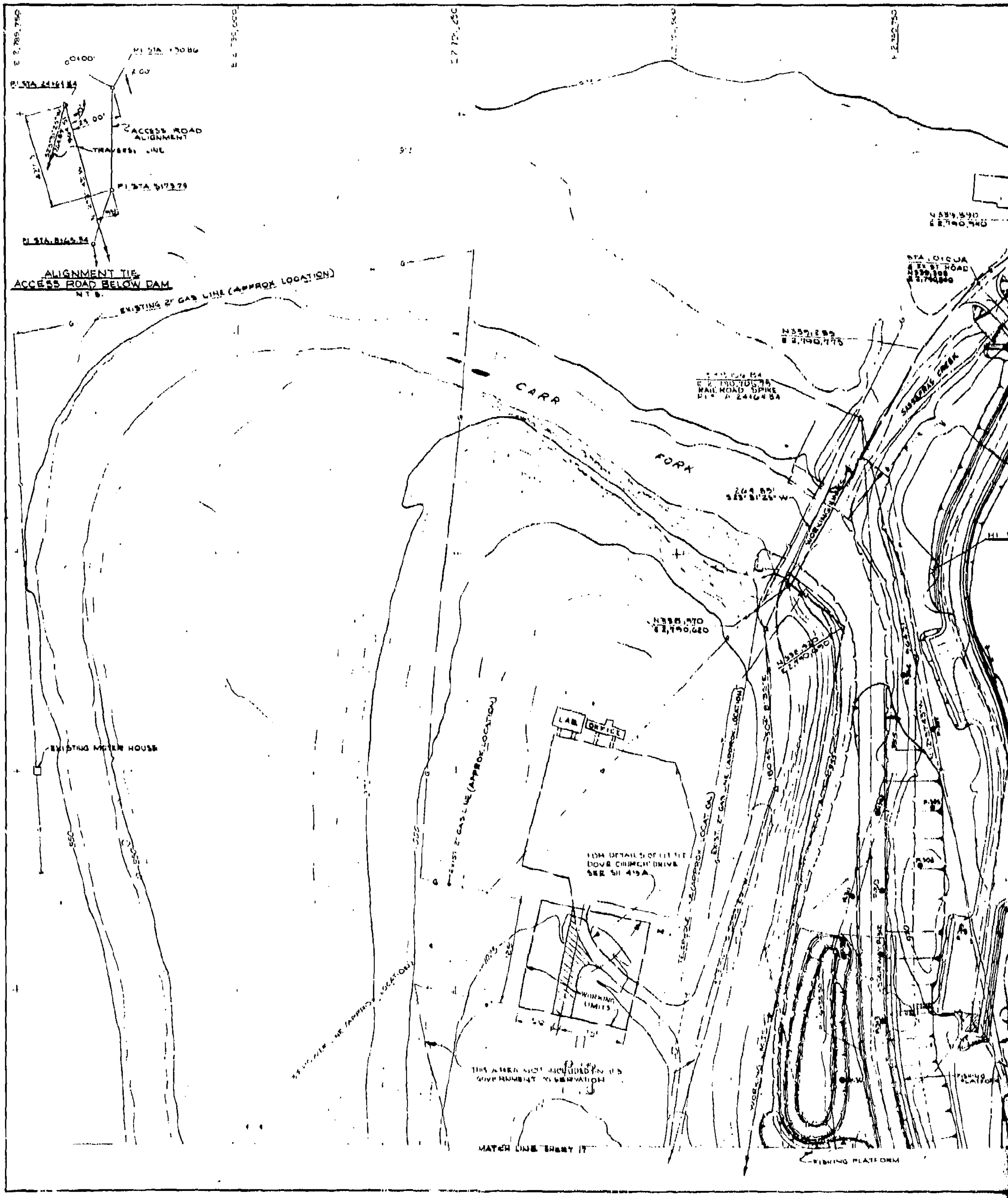

U. S. ARMY
INSERT
MATCH SHEET 16
CARR
FORK
EL 1092
NOTE:
FOR GRAPHIC LOGS OF BORINGS WITHIN CONDUIT AREA SEE REFERENCE DRAWINGS.
SCALE: 1" : 50'
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
KENTUCKY RIVER BASIN
CARR FORK LAKE
DAM & SPILLWAY
BORING LOCATION PLAN-
DAM AND SPILLWAY
SHEET-1
C.T.B.
7 APRIL '72
NFK 83-42.8/17

PLATE 1

CORPS OF ENGINEERS



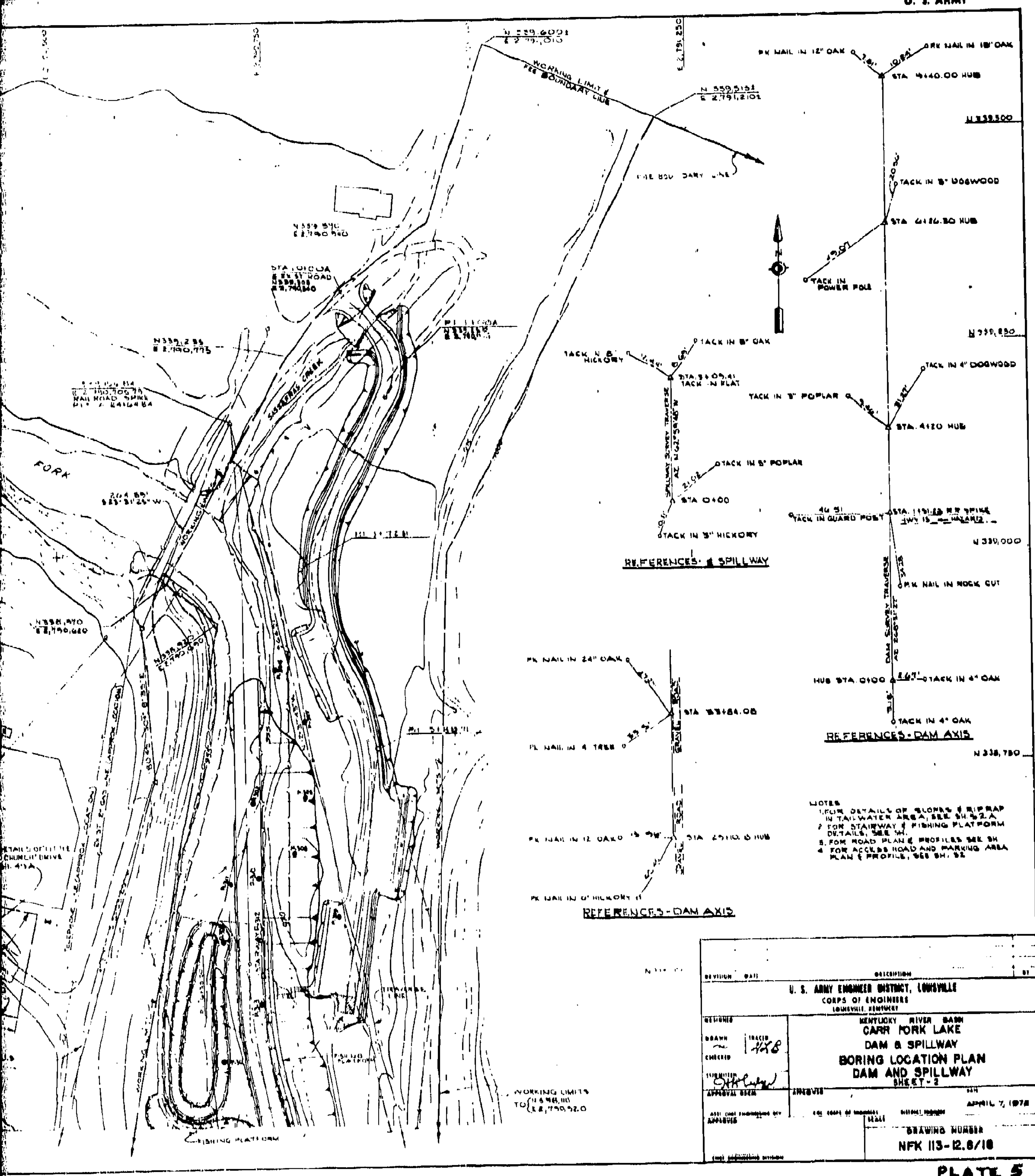
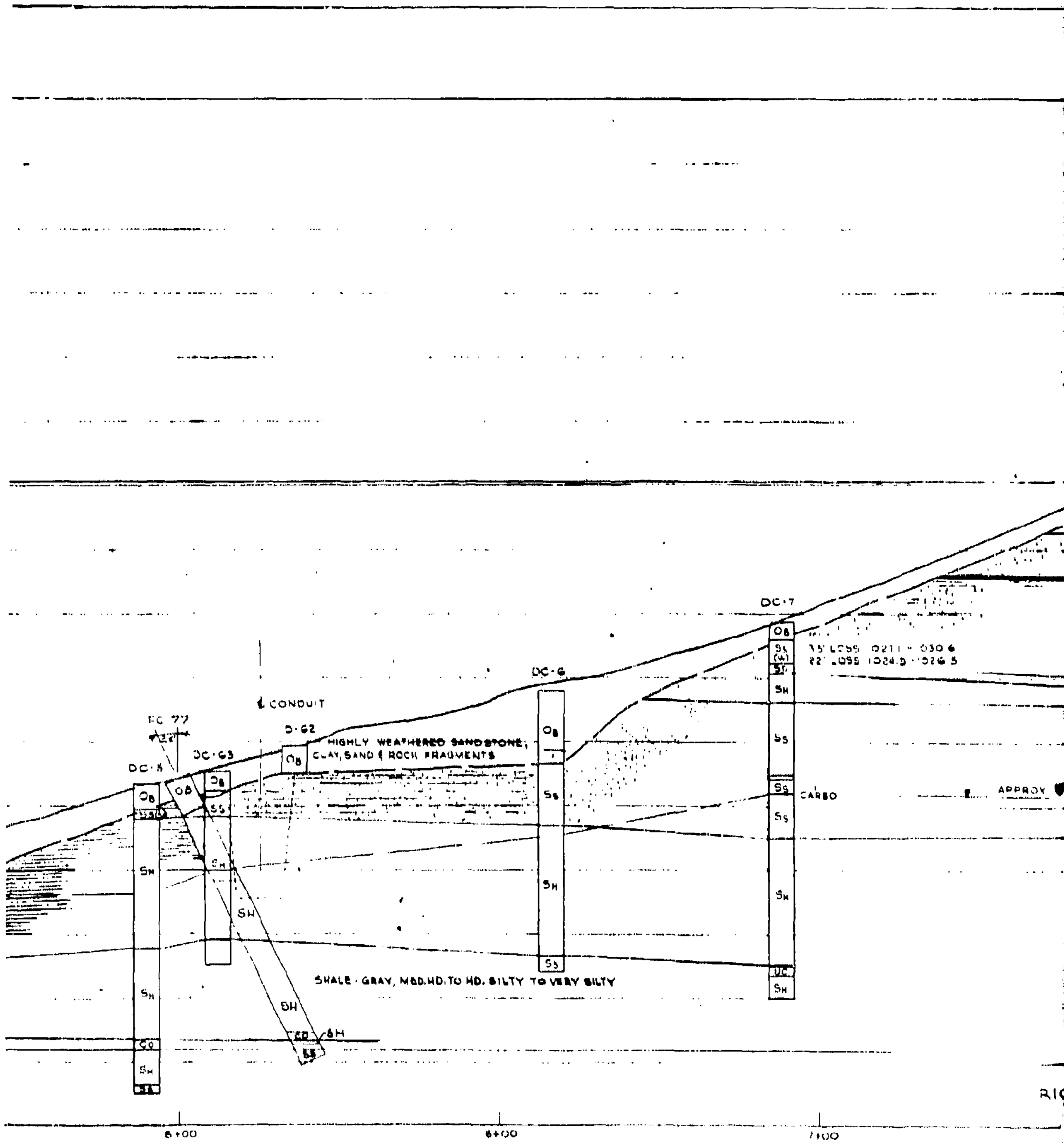


PLATE 5

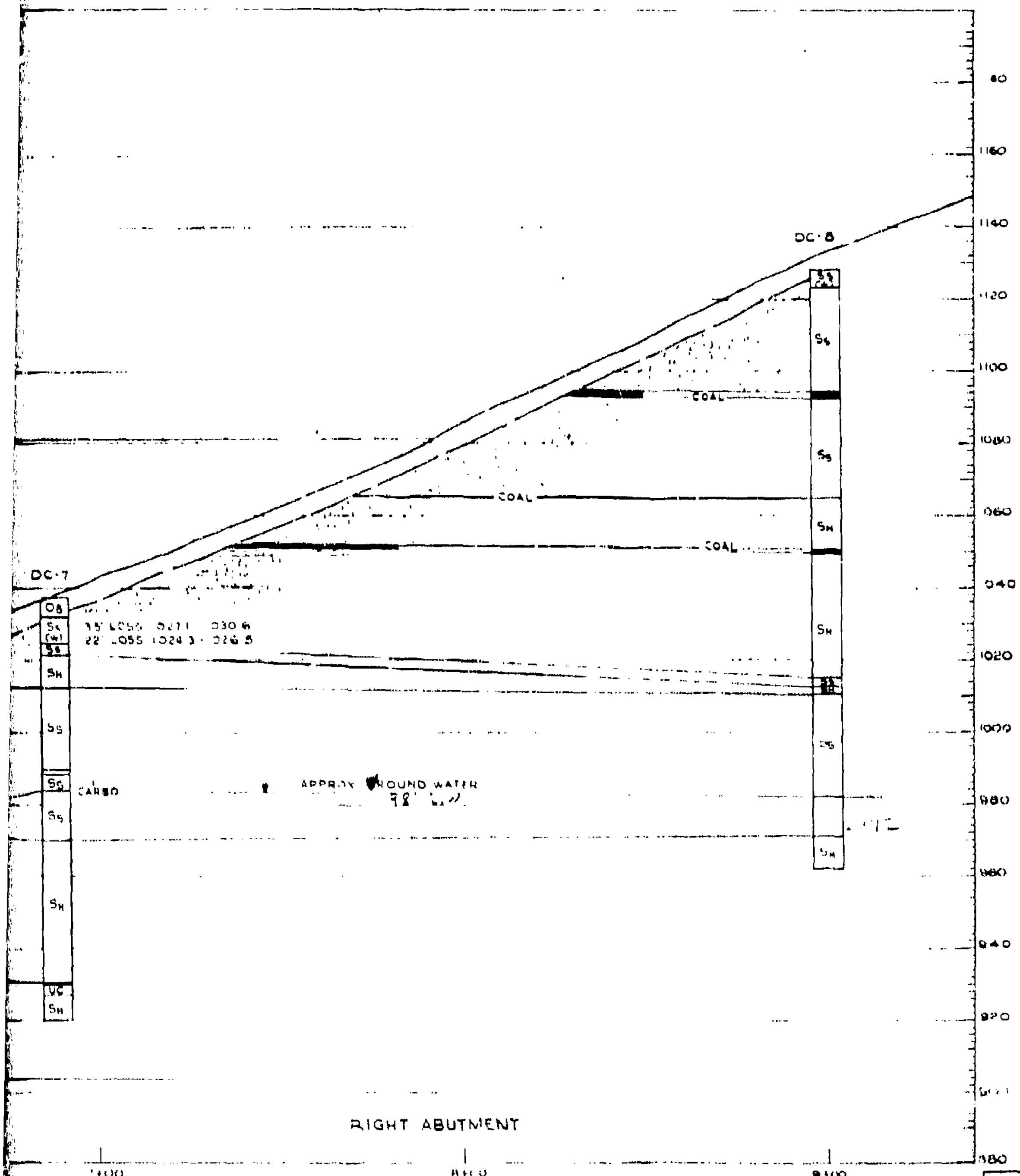
CARR FORK

2



DC-7
DC-6
DC-5
DC-63
D-62
FC 77
℄ CONDUIT
HIGHLY WEATHERED SANDSTONE, CLAY, SAND & ROCK FRAGMENTS
SHALE - GRAY, MED.HD. TO HD. SILTY TO VERY SILTY
CARBO
APPROX
5+00
6+00
7+00

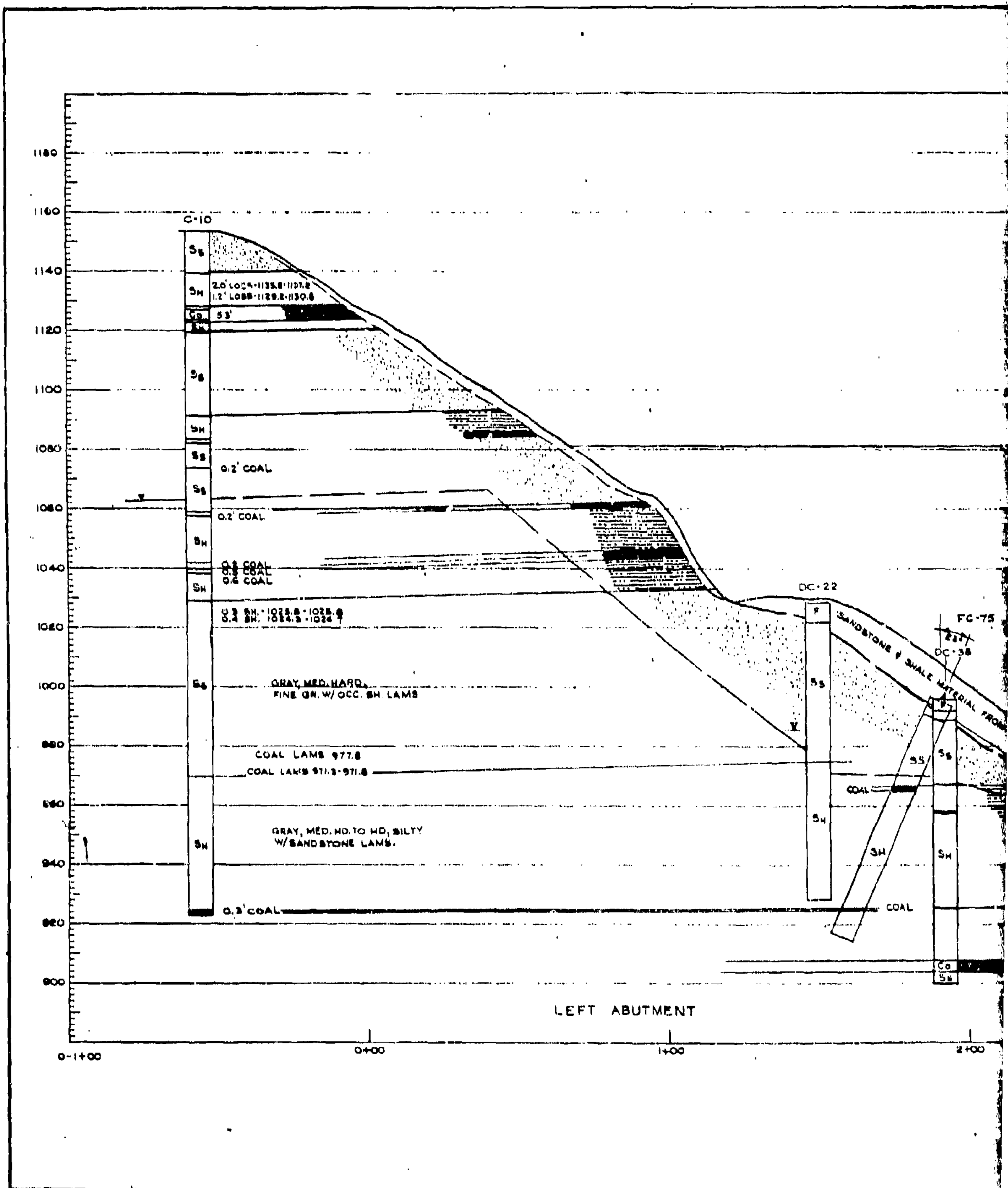
AXIS



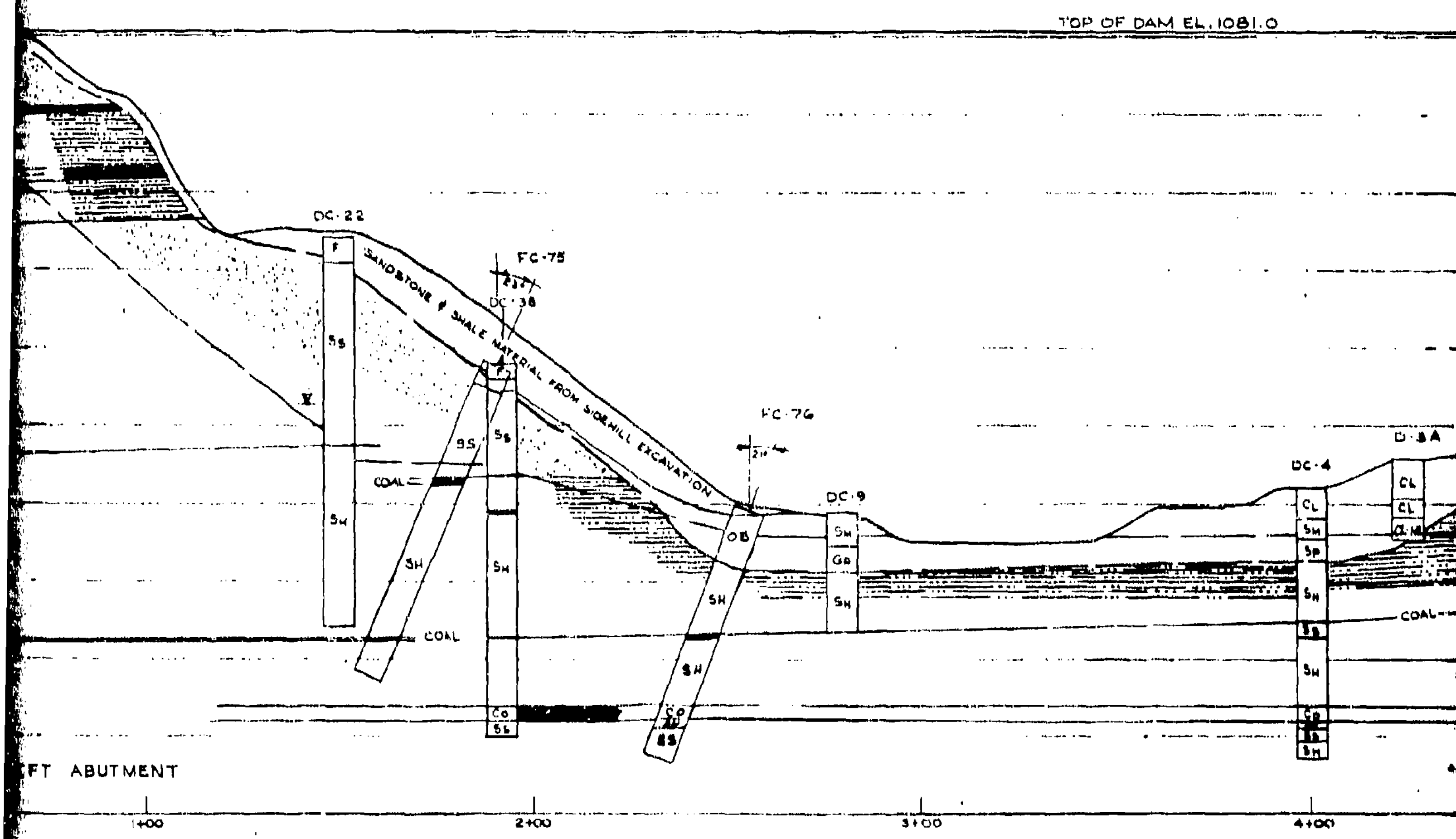
KENTUCKY RIVER BASIN, KY.
CARR FORK RESERVOIR

GEOLOGIC PROFILE ON DAM AXIS

PLATE 6



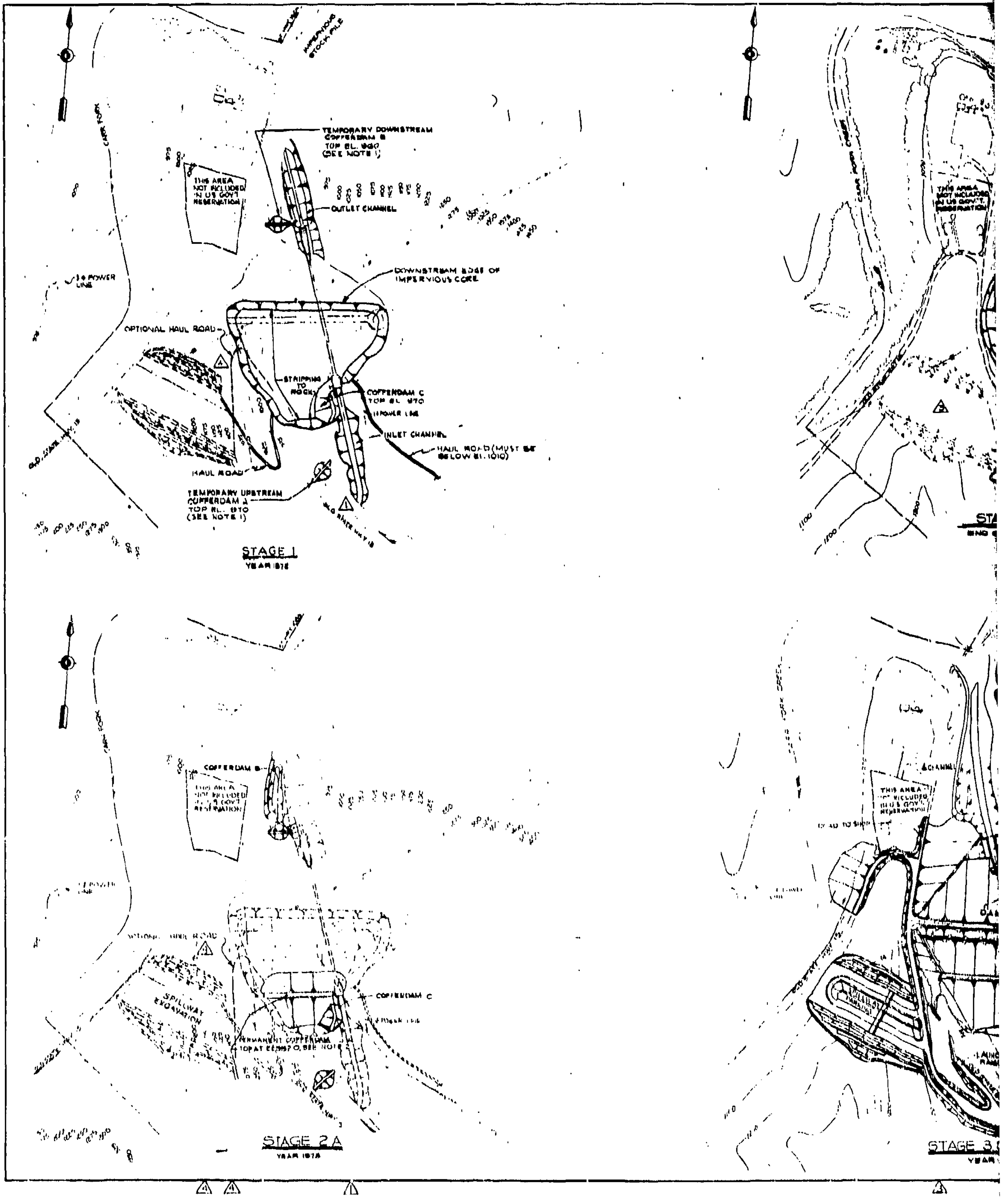
1180
1160
1140
1120
1100
1080
1060
1040
1020
1000
980
960
940
920
900
C-10
SS
SH
2.0' LOSS-1135.8-1137.8
1.2' LOSS-1129.8-1130.8
CO
SS
0.2' COAL
0.2' COAL
0.6 COAL
GRAY, MED. HARD, FINE GR. W/ OCC. SH LAMS
COAL LAMS 977.8
GRAY, MED. HD. TO HD, SILTY W/ SANDSTONE LAMS.
0.3' COAL
DC-22
FC-75
DC-38
SANDSTONE & SHALE MATERIAL FROM
COAL
LEFT ABUTMENT
0-1+00
0+00
1+00
2+00

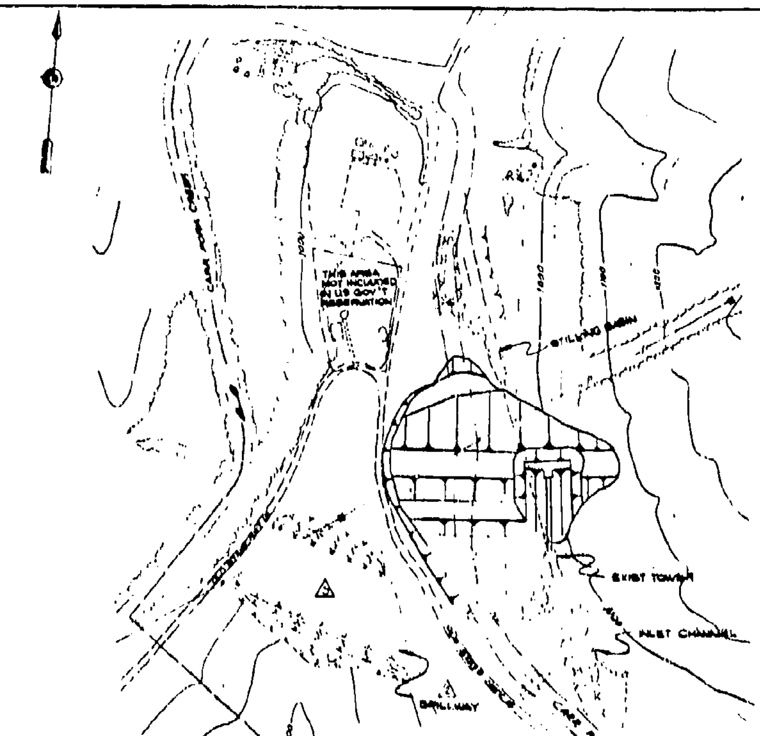


GEOLOGIC PROFILE OF DA
VIEW DOWNSTREAM

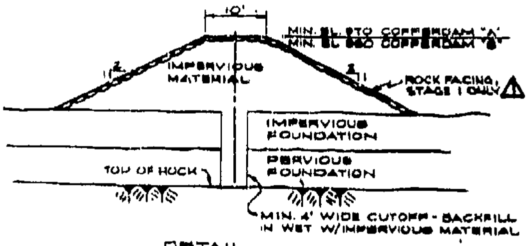
PLATE 6A2

CORPS OF ENGINEERS

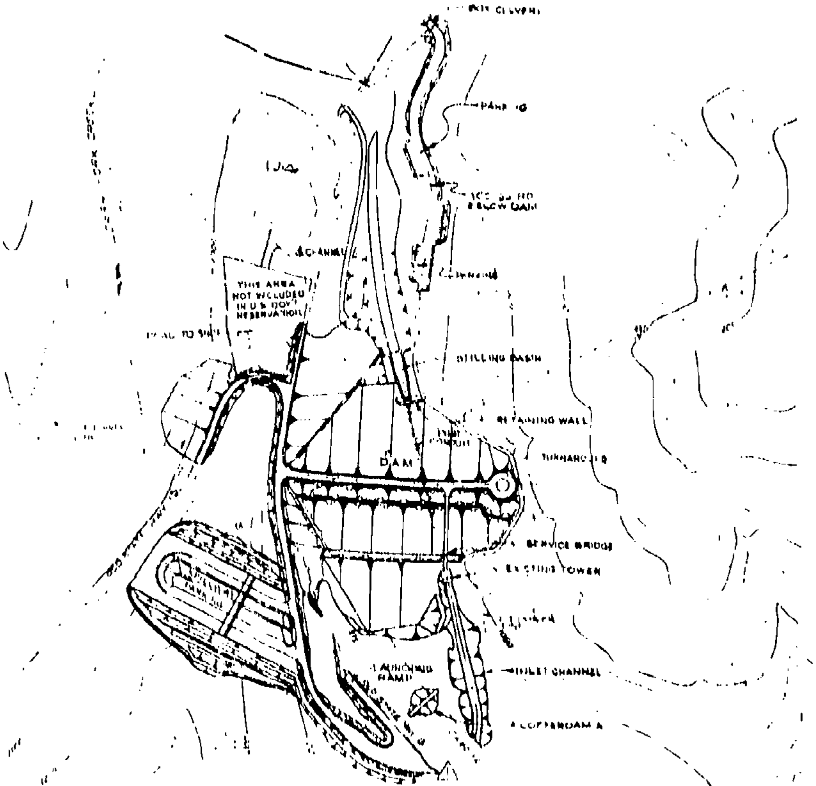




STAGE 2 B
END OF YEAR 1973



DETAIL
TEMPORARY DIVERSION COFFERDAMS "A" & "B"
NO SCALE



STAGE 3 COMPLETED
MAR 1974

NOTES
1. COFFERDAMS A & B ARE TO BE CONSTRUCTED AT START OF CONTRACT (1972) AND STREAM DIVERTED THRU OUTLET WORKS AND COFFERDAMS REMOVED BY 1 NOV 1972. AFTER 1 MAY 1973 COFFERDAMS A & B ARE TO BE RECONSTRUCTED AND STREAM DIVERTED THROUGH OUTLET WORKS
2. THE PERMANENT COFFERDAM SHALL BE CONSTRUCTED TO EL 988 UNDER A [illegible] RATE OF PLACEMENT AND WITHIN A CERTAIN TIME LIMIT. FOR DETAILS, SEE SPECS
3. PARTIAL SECTION OF DAM SHALL BE COMPLETED BY 1 NOV 1973

REVISION	DATE	DESCRIPTION	BY
4	14 JUN 72	OPTIONAL HAUL ROAD (AMDT NO 6)	[illegible]
3	1 JUN 72	SPILLWAY DIM DELETED (AMDT. NO 5)	J.J.S
2	19 MAY 72	WORD "EXISTING" DELETED (AMDT. NO 4)	JMB
1	1 MAY 72	ROCK FACING ADDED, GAS LINE REMOVED (AMDT NO 1)	J.J.S

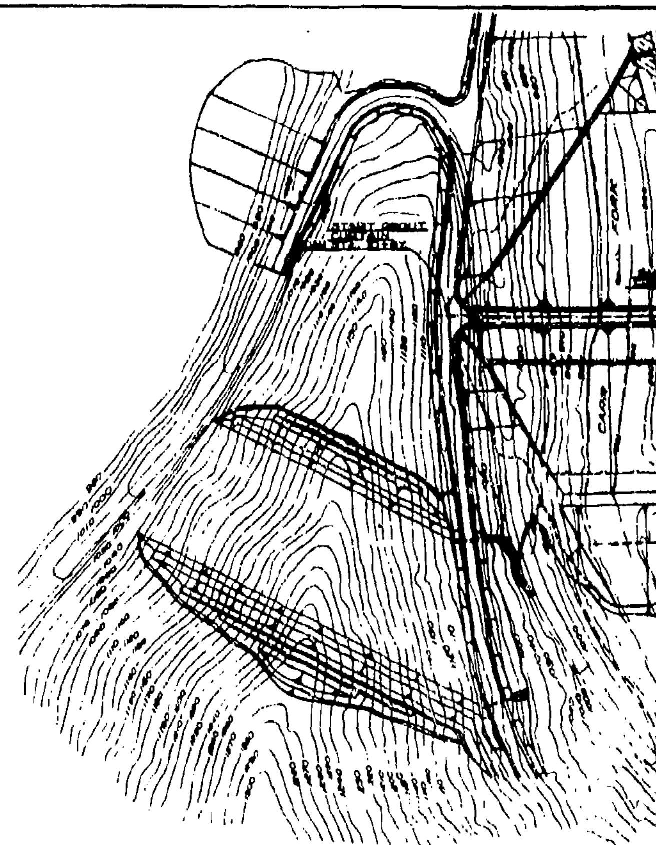
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

KENTUCKY RIVER BASIN
CARR FORK LAKE
DAM & SPILLWAY
SEQUENCE OF CONSTRUCTION

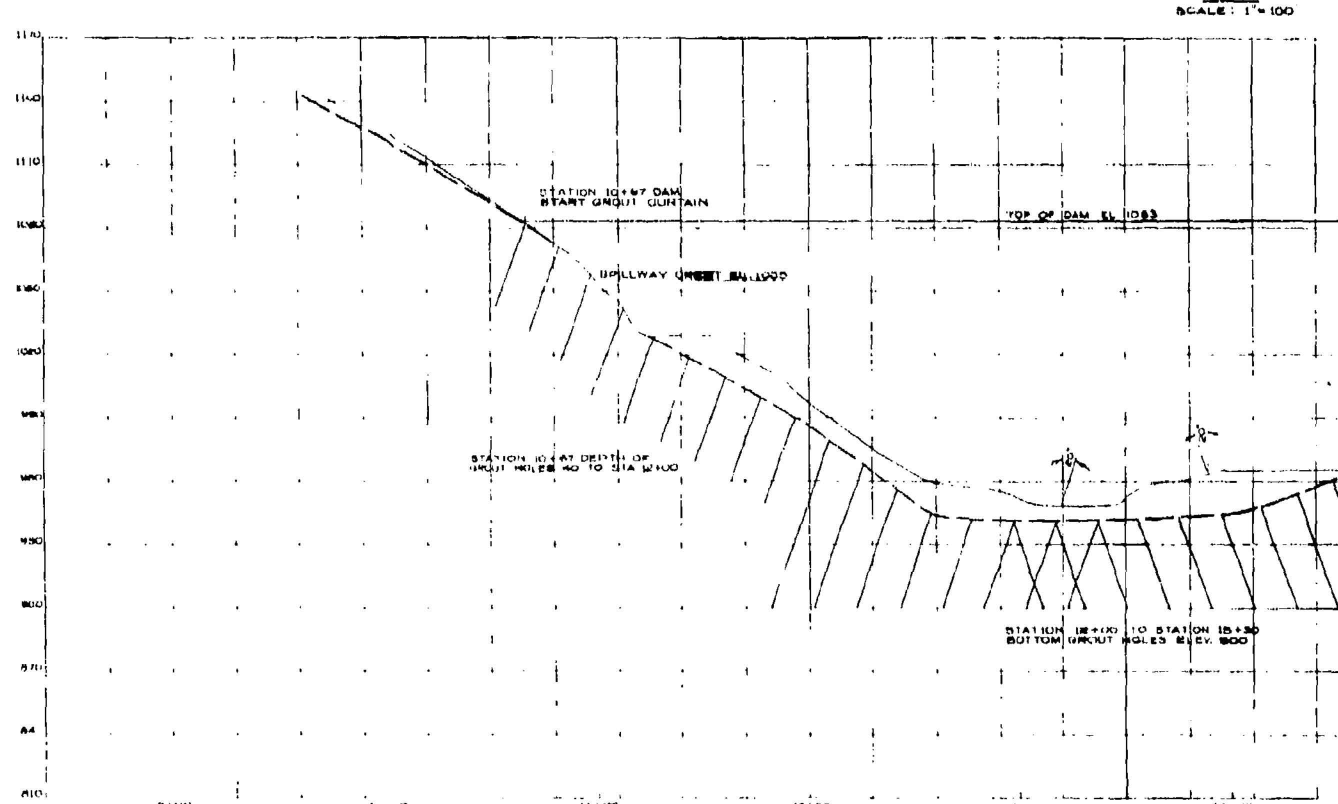
DESIGNED V.V.A
DRAWN M.G.L. TRACED MOR
CHECKED [illegible]
SUBMITTED [illegible]
SCALE 1" = 800'
DATE
DRAWING NUMBER
NFK 113-12.8/5

2

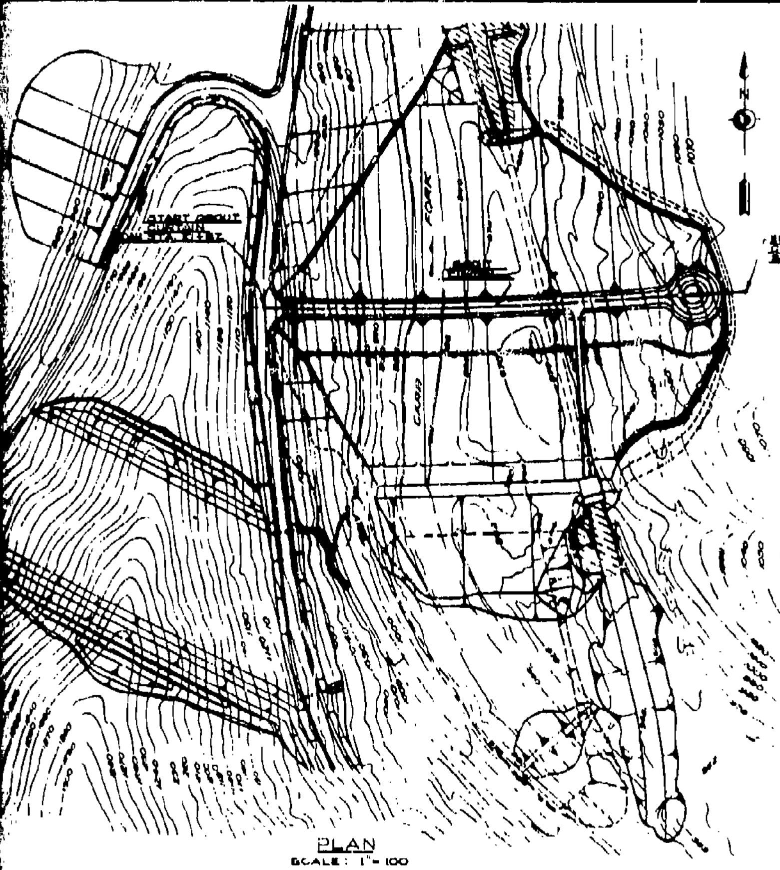
CORPS OF ENGINEERS



PLAN
SCALE: 1"=100



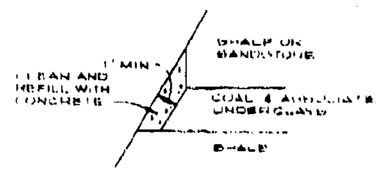
℄ DAM PROFILE GROUT CURTAIN
SCALE: 1"=50'

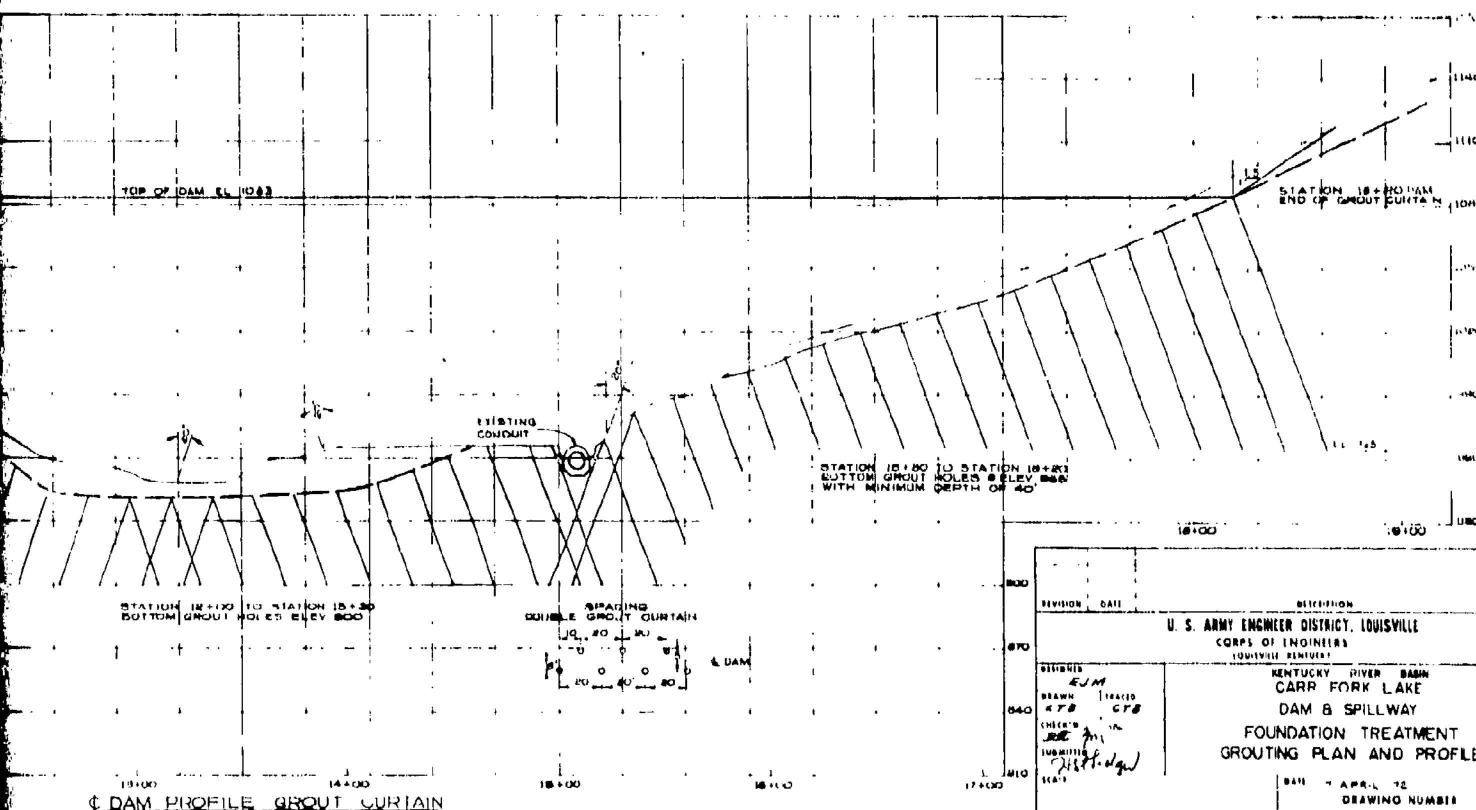


PLAN
SCALE: 1"=100

NOTES.

1. ALL LOOSE WEATHERED ROCK ON FOUNDATION AND ABUTMENTS WITHIN LIMITS OF IMPERVIOUS EARTH CORE SHALL BE REMOVED PRIOR TO SLUSH GROUTING.
2. ALL VERTICAL ROCK EXPOSURES OVER 2' IN HEIGHT AND ALL ROCK OVER-HANGING LEDGES WITHIN LIMITS OF THE IMPERVIOUS CORE SHALL BE EXCAVATED TO A MAXIMUM SLOPE OF 4V ON 1H PRIOR TO SLUSH GROUTING.
3. ALL VERTICAL ROCK EXPOSURES OVER 2' IN HEIGHT AND ALL ROCK OVER-HANGING LEDGES WITHIN LIMITS OF THE RANDOM FILL SHALL BE EXCAVATED TO A MAXIMUM SLOPE OF 4V ON 1H PRIOR TO COMPACTION OF RANDOM FILL.
4. FILLING OF CRACKS OR FISSURES WITHIN THE SPECIAL TREATMENT AREA AND FOUNDATION AREA SHALL BE WITH SLUSH GROUT, BUT LIMITED TO THE OPENINGS IN THE ROCK SURFACE, AND THIN LAYERS OF SLUSH GROUT SHALL NOT COVER SURFACE AREAS OF SOUND ROCK WHERE IT MIGHT CRACK OFF UNDER ROLLING ACTION.
5. A FINAL CLEANUP IN THE SPECIAL TREATMENT AREA SHALL BE MADE JUST PRIOR TO PLACING FILL.
6. THE FOUNDATION SHALL BE STRIPPED IN ITS ENTIRETY UNDER THE DAM AND HIGHWAY FILL [illegible] ADJACENT TO THE DAM.
7. THE COAL AND ASSOCIATED UNDERCLAY SEAMS IN THE ABUTMENTS UNDER THE IMPERVIOUS CORE OF THE EMBANKMENT SHALL BE REMOVED TO A MINIMUM DEPTH OF ONE FOOT AND REFILLED WITH CONCRETE.





℄ DAM PROFILE GROUT CURTAIN
SCALE: 1"=50'

REVISION	DATE	DESCRIPTION	BY

U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

DESIGNED EJM
DRAWN KTB | TRACED CTB
CHECKED
SUBMITTED
SCALE

KENTUCKY RIVER BASIN
CARR FORK LAKE
DAM & SPILLWAY
FOUNDATION TREATMENT
GROUTING PLAN AND PROFILE

DATE 7 APRIL 72
DRAWING NUMBER
NFK 113-12.8/8

PLATE 8

2

CORPS OF ENGINEERS

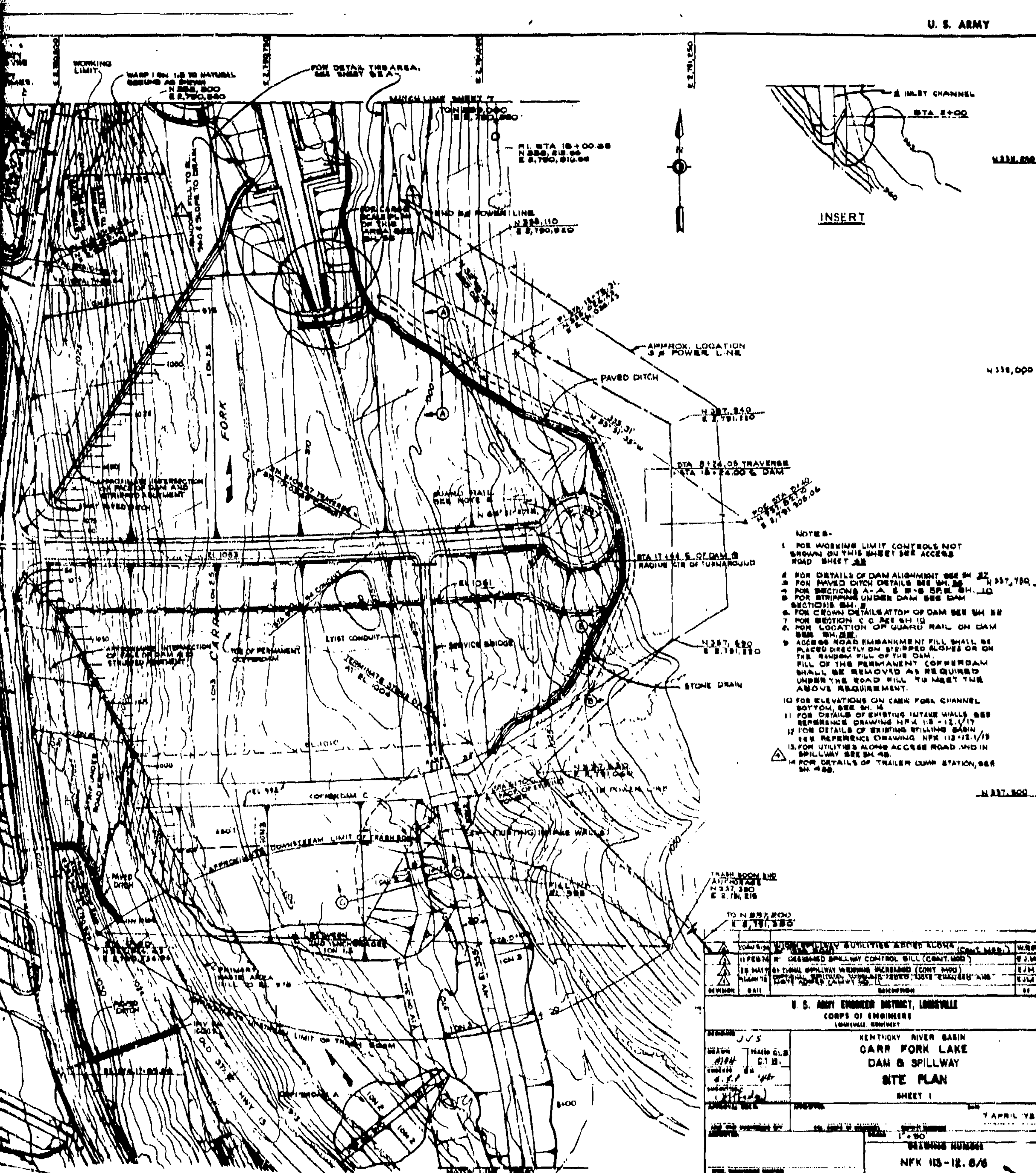
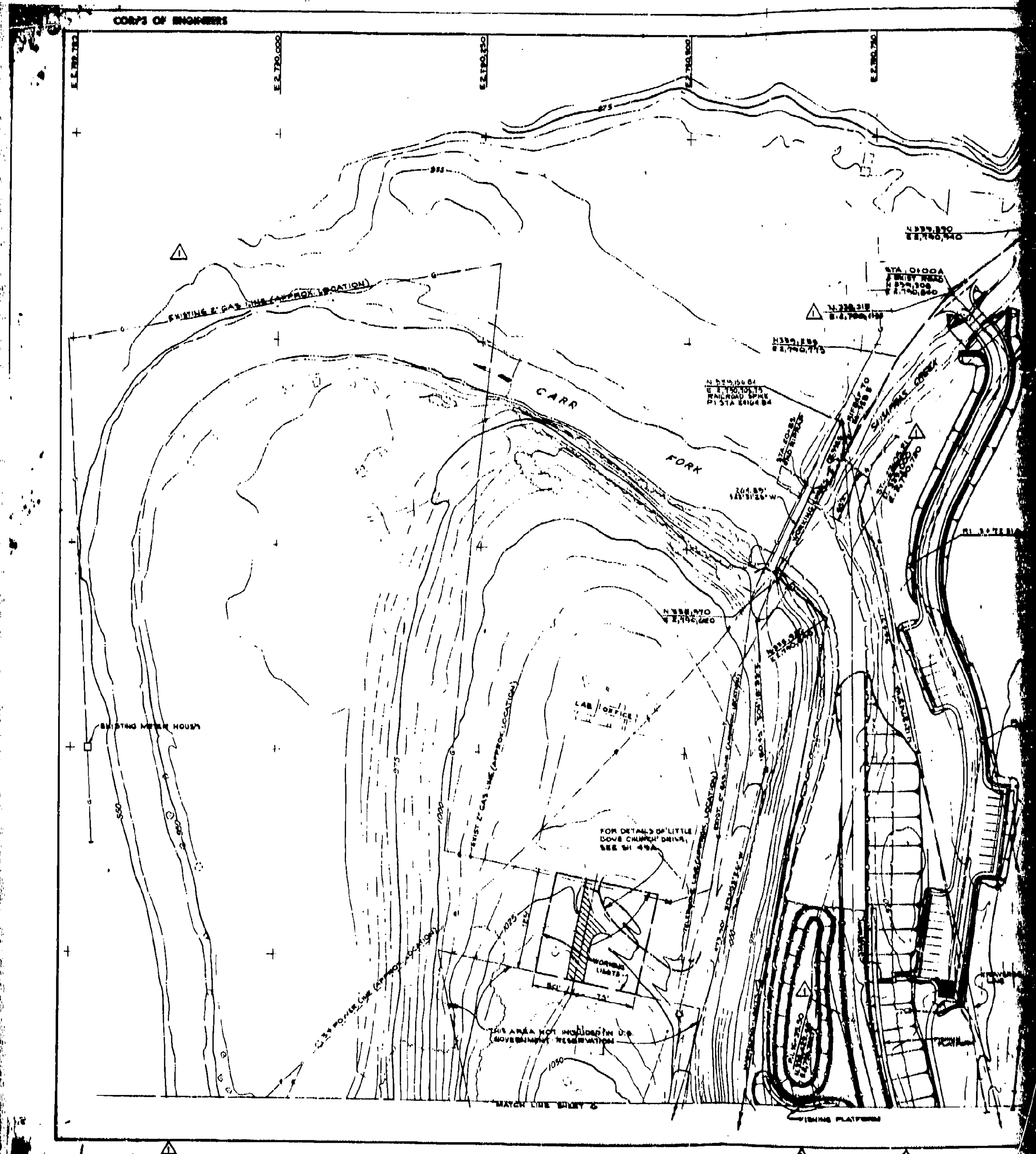

U. S. ARMY
INSERT
APPROX. LOCATION 3 ∅ POWER LINE
PAVED DITCH
STONE DRAIN
CARR FORK
SERVICE BRIDGE
EXIST CONDUIT
TOE OF PERMANENT COFFERDAM
DOWNSTREAM LIMIT OF TRASH BOOM
EXISTING INTAKE WALLS
PRIMARY WASTE AREA
TRASH BOOM END ANCHORAGE N 337,380 E 2,791,215
NOTES-
1 FOR WORKING LIMIT CONTROLS NOT SHOWN ON THIS SHEET SEE ACCESS ROAD SHEET
2 FOR DETAILS OF DAM ALIGNMENT SEE SH.
3 FOR PAVED DITCH DETAILS SEE SH.
4 FOR SECTIONS A-A & B-B SEE SH. 10
5 FOR STRIPPING UNDER DAM SEE DAM SECTIONS SH.
6 FOR CROWN DETAILS AT TOP OF DAM SEE SH.
7 FOR SECTION C-C SEE SH 10
8 FOR LOCATION OF GUARD RAIL ON DAM SEE SH.
9 ACCESS ROAD EMBANKMENT FILL SHALL BE PLACED DIRECTLY ON STRIPPED SLOPES OR ON THE RANDOM FILL OF THE DAM. FILL OF THE PERMANENT COFFERDAM SHALL BE REMOVED AS REQUIRED UNDER THE ROAD FILL TO MEET THE ABOVE REQUIREMENT.
10 FOR ELEVATIONS ON CARR FORK CHANNEL BOTTOM, SEE SH. 14
11 FOR DETAILS OF EXISTING INTAKE WALLS SEE REFERENCE DRAWING NFK 113-12.1/17
12 FOR DETAILS OF EXISTING STILLING BASIN SEE REFERENCE DRAWING NFK 113-12.1/19
13. FOR UTILITIES ALONG ACCESS ROAD AND IN SPILLWAY SEE SH. 45.
14 FOR DETAILS OF TRAILER DUMP STATION, SEE SH. 45.
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY
KENTUCKY RIVER BASIN
CARR FORK LAKE
DAM & SPILLWAY
SITE PLAN
SHEET 1
7 APRIL '78
NFK 113-12. 6/6

PLATE 9



CORPS OF ENGINEERS
EXISTING 2" GAS LINE (APPROX LOCATION)
CARR
FORK
RAILROAD SPIKE
EXISTING METER HOUSE
LAB
OFFICE
FOR DETAILS OF LITTLE DOVE CHURCH DRIVE, SEE SH 49A
WORKING LIMITS
THIS AREA NOT INCLUDED IN U.S. GOVERNMENT RESERVATION
FISHING PLATFORM

U. S. ARMY

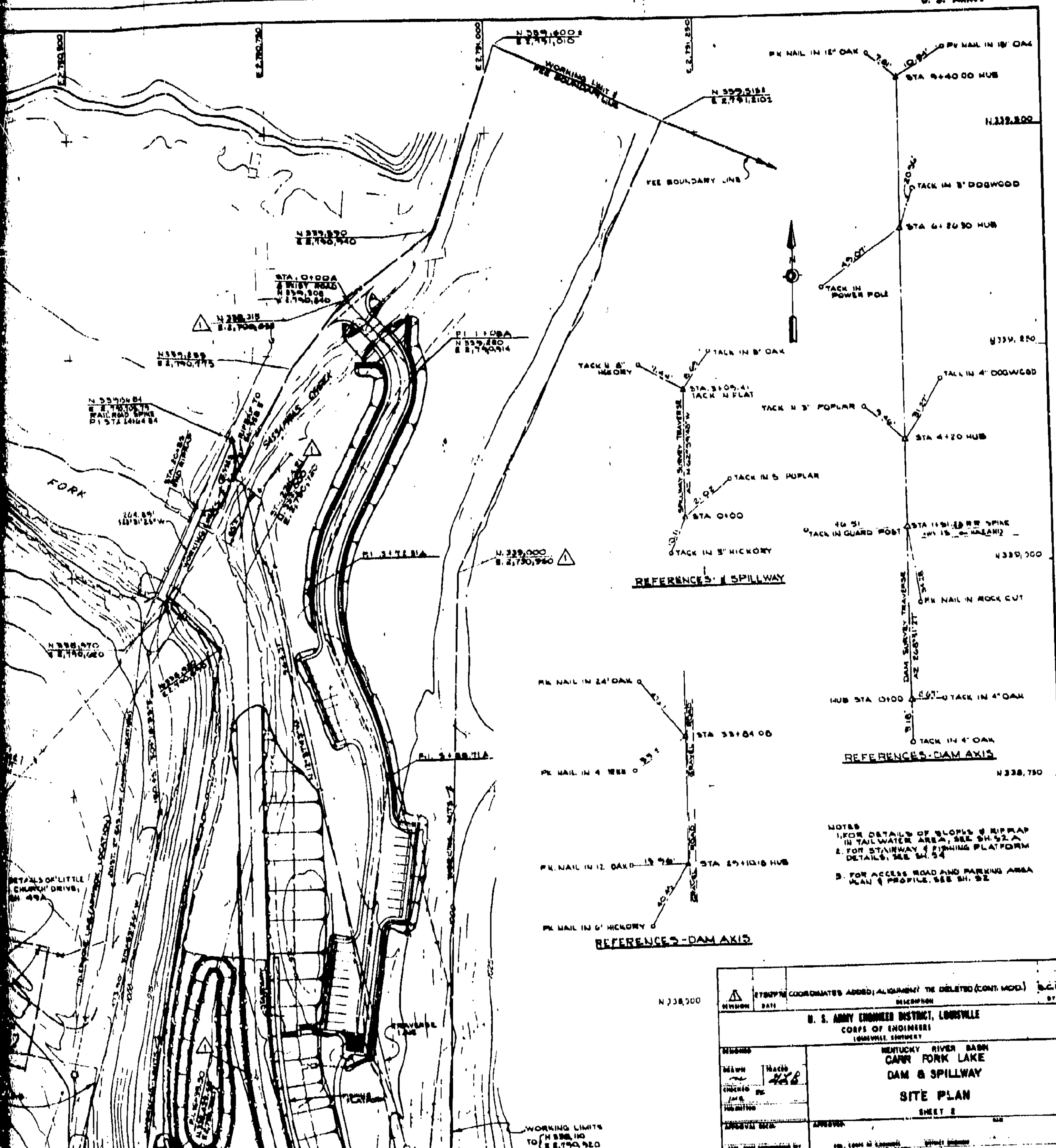
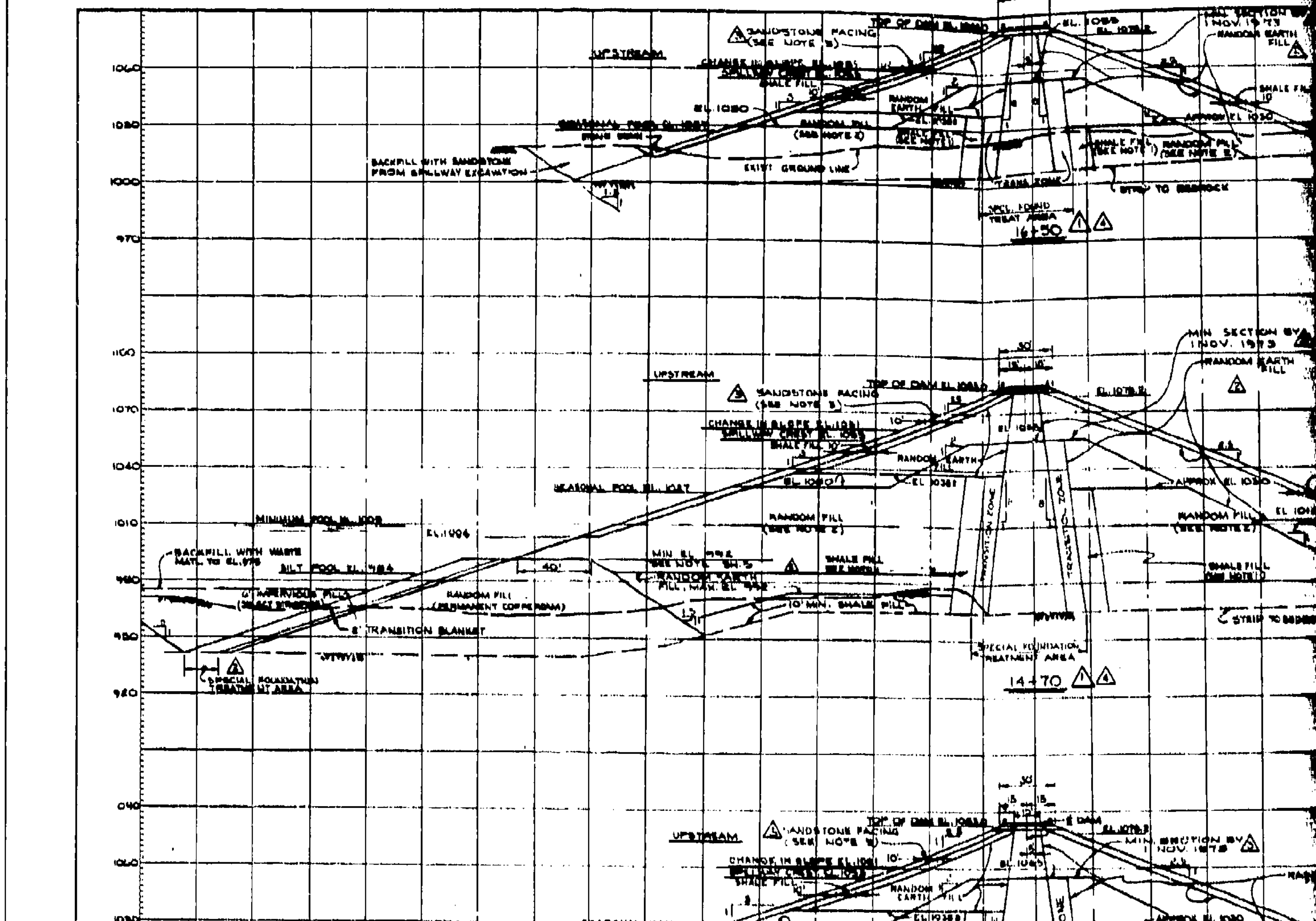
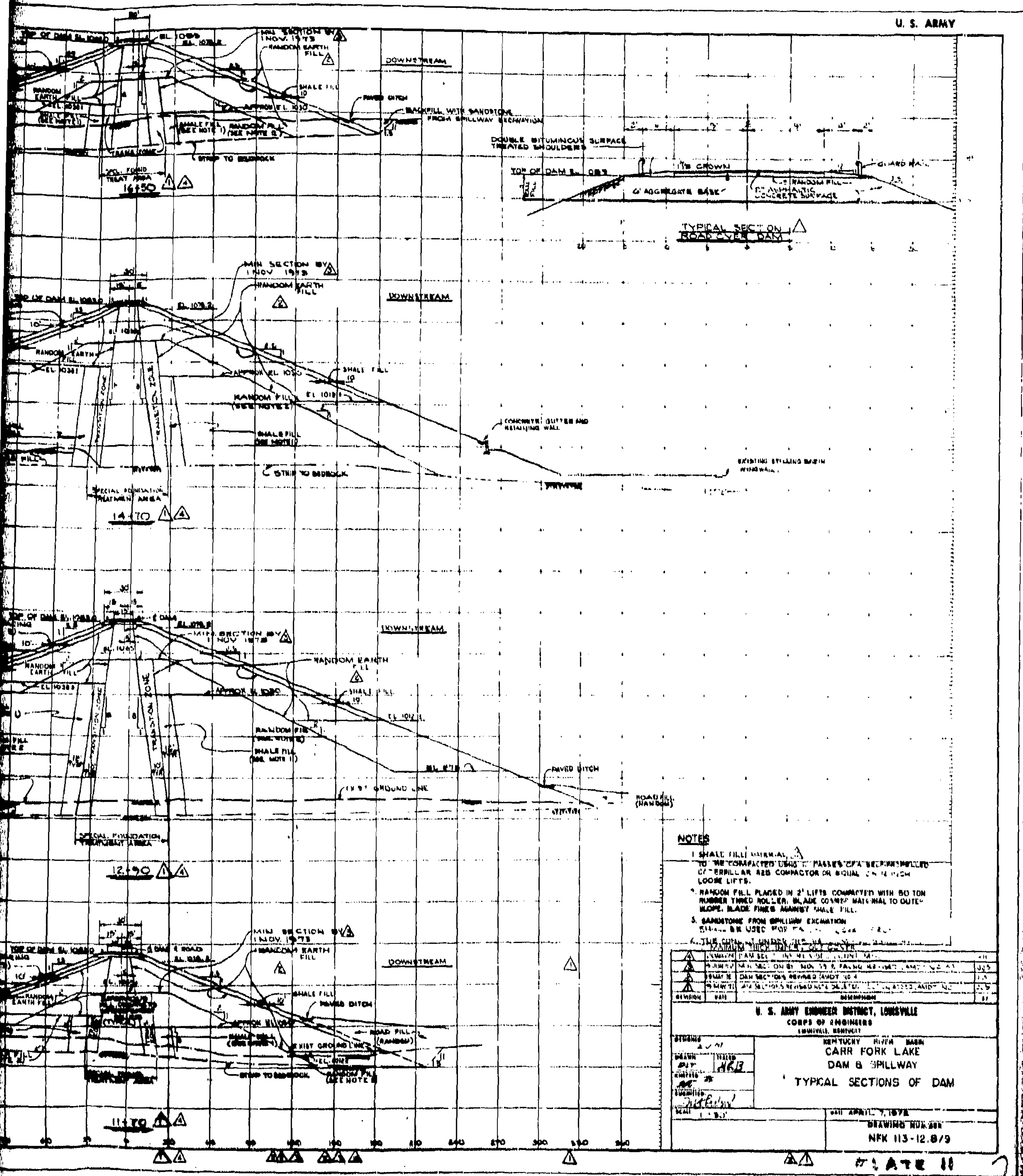


PLATE 10

CORPS OF ENGINEERS




U. S. ARMY
DOWNSTREAM
RANDOM EARTH FILL
SHALE FILL
PAVED DITCH
BACKFILL WITH SANDSTONE FROM SPILLWAY EXCAVATION
STRIP TO BEDROCK
16+50
DOUBLE BITUMINOUS SURFACE TREATED SHOULDERS
GUARD RAIL
TOP OF DAM EL. 1083
6" AGGREGATE BASE
TYPICAL SECTION ON ROAD OVER DAM
MIN. SECTION BY 1 NOV. 1973
CONCRETE GUTTER AND RETAINING WALL
EXISTING STILLING BASIN WINGWALL
SPECIAL FOUNDATION TREATMENT AREA
14+70
TRANSITION ZONE
EXIST. GROUND LINE
ROAD FILL (RANDOM)
12+90
11+70
NOTES
1. SHALE FILL MATERIAL TO BE COMPACTED USING PASSES OF A CATERPILLAR 825 COMPACTOR OR EQUAL IN INCH LOOSE LIFTS.
2. RANDOM FILL PLACED IN 2' LIFTS COMPACTED WITH 50 TON RUBBER TIRED ROLLER. BLADE COARSE MATERIAL TO OUTER SLOPE. BLADE FINES AGAINST SHALE FILL.
3. SANDSTONE FROM SPILLWAY EXCAVATION SHALL BE USED FOR
DAM SECTIONS REVISED AMDT NO 4
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY
KENTUCKY RIVER BASIN
CARR FORK LAKE
DAM & SPILLWAY
TYPICAL SECTIONS OF DAM
DATE APRIL 7, 1972
DRAWING NUMBER
NFK 113-12.8/9
PLATE 11

Carr Fork Lake
Materials Usage Chart
Excavation

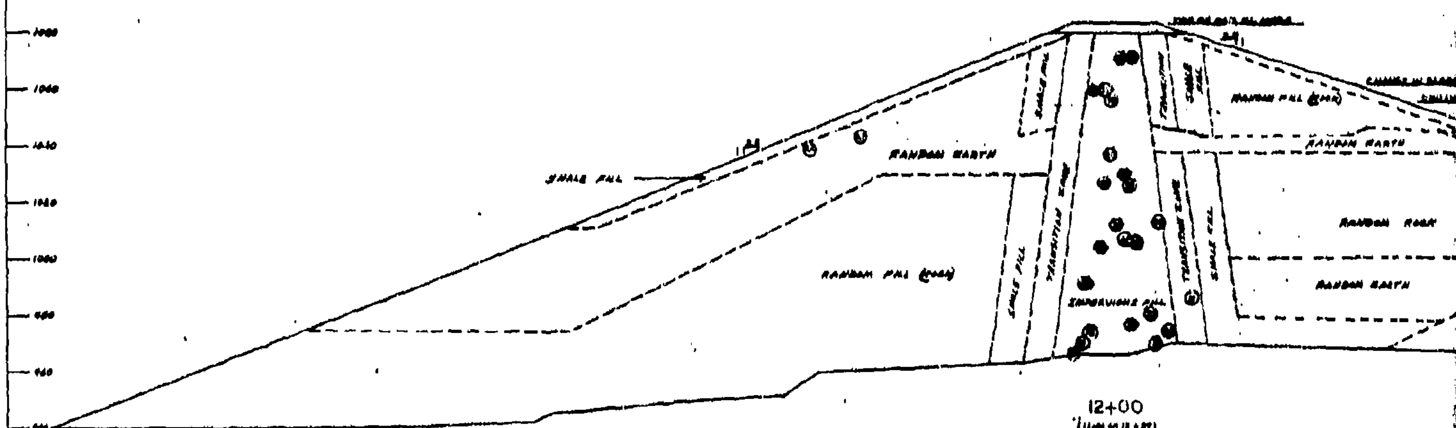
Item	Excavated Quantity CY	Total Quantity CY	Disposition	Disposition Excavation Quantity CY	Balance Factor	Embankment Quantity CY
Topsoil						
Dam	23,900	36,000	Waste Area	36,000		
Spillway	12,100					
Earth Excavation						
Dam Foundation	180,500		Waste Area	123,500		
Spillway	12,400	322,900	Impervious Fill	82,900	0.83	69,000
Storage Area A	94,000		Random Fill	116,500	0.83	96,700
Storage Area B	36,000					
Rock Excavation						
Dam Foundation	1,300					
Spillway Area						
Shale	172,600		Shale Fill	49,300	1.15	56,700
Sandstone	385,300	718,600	Transition Blanket	3,100	1.15	3,600
Coal	40,700		Coal (Waste)	40,700		
Underclay	40,000		Underclay (Waste)	40,000		
Borrow	78,100		Random Fill	584,900	1.15	672,700

Carr Fork Lake

Materials Usage Chart

Fill

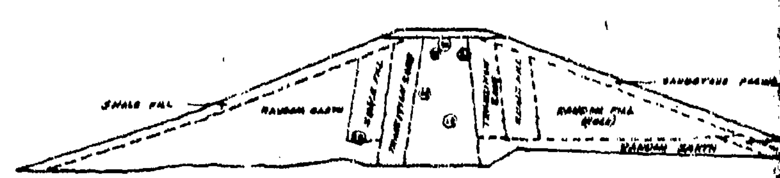
Item	Fill Quantity	Source	Total
Impervious Fill	30,700	Dam Area	69,000
	38,300	Storage Area A	
Shale Fill	56,700	Spillway	56,700
Rardom Rock Fill	581,300	Spillway	
	89,900	Borrow	672,700
	1,500	Dam Area	
Transition Blanket	3,600	Spillway	3,600
Random Earth Fill	16,600	Dam Area	
	10,300	Spillway	96,700
	39,900	Storage Area A	
	29,900	Storage Area B	
Graded Aggregate	48,000	Commercial	48,000



12+00

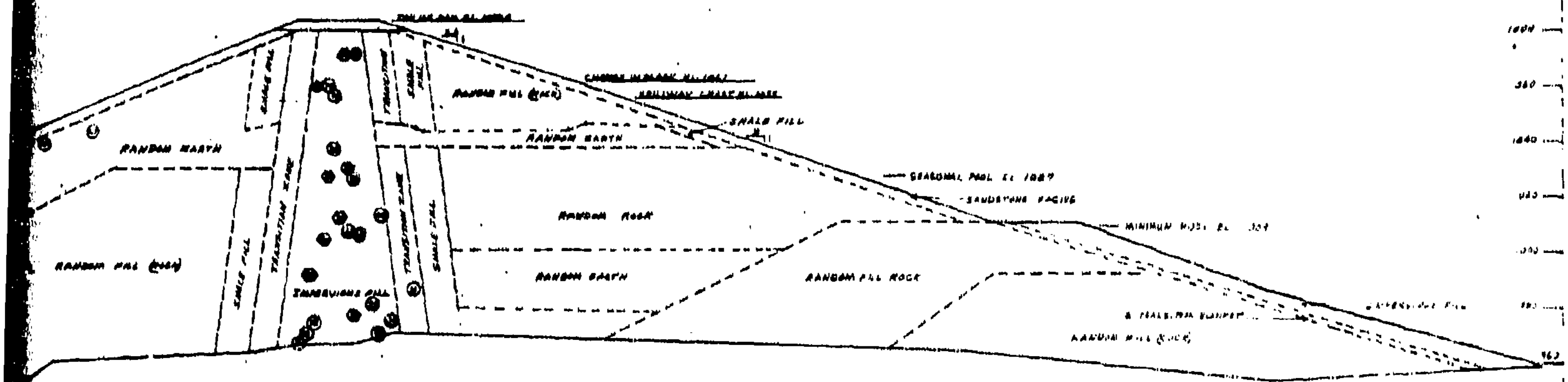
[illegible]	[illegible]	SOURCE OF MATERIAL
[illegible]	11+10	STORAGE "A"
35	11+[illegible]	" "
[illegible]	11+[illegible]	" "
[illegible]	11+47	" "
[illegible]	11+[illegible]	" "
[illegible]	11+[illegible]	" "
[illegible]	11+[illegible]	ACCESS RD.
[illegible]	11+[illegible]	D.S. STORAGE
[illegible]	11+[illegible]	D.S. STORAGE
[illegible]	11+[illegible]	STORAGE "A"
[illegible]	11+[illegible]	" "
[illegible]	11+[illegible]	" "
[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	SOURCE OF MATERIAL
[illegible]	11+[illegible]	STORAGE "A"
[illegible]	11+[illegible]	" "
[illegible]	11+[illegible]	BORROW "A"
[illegible]	11+[illegible]	STORAGE "A"
[illegible]	11+[illegible]	" "
[illegible]	[illegible]	" "
[illegible]	[illegible]	" "
[illegible]	[illegible]	D.S. STORAGE
[illegible]	[illegible]	STORAGE "A"
[illegible]	[illegible]	"QUARRY"
[illegible]	[illegible]	STORAGE "A"
[illegible]	[illegible]	D.S. STORAGE
[illegible]	[illegible]	[illegible]



11+00

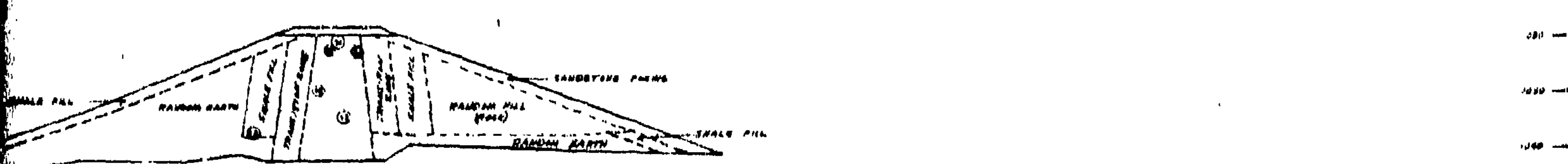
[illegible]	[illegible]	SOURCE OF MATERIAL
[illegible]	[illegible]	[illegible] STORAGE
[illegible]	[illegible]	" "
[illegible]	10+[illegible]	" "
[illegible]	10+[illegible]	" "
[illegible]	[illegible]	" "
[illegible]	11+[illegible]	" "



12+00

TEST NO.	STATION	SOURCE OF MATERIAL
36	11+10	STORAGE "A"
39	11+20	" "
[illegible]	11+40	" "
[illegible]	11+47	" "
[illegible]	11+47	" "
[illegible]	11+50	" "
[illegible]	11+80	ACCESS RD.
[illegible]	11+[illegible]	D.S. STORAGE
[illegible]	11+[illegible]	D.S. STORAGE
30	11+[illegible]	STORAGE "A"
[illegible]	11+62	" "
[illegible]	11+[illegible]	" "
[illegible]	[illegible]	QUARRY

TEST NO.	STATION	SOURCE OF MATERIAL
[illegible]	11+75	STORAGE "A"
41	11+75	" "
57	11+75	BORROW "A"
19	11+76	STORAGE "A"
[illegible]	11+[illegible]	" "
14	[illegible]	" "
[illegible]	12+00	" "
[illegible]	12+[illegible]	D.S. STORAGE
[illegible]	12+05	STORAGE "A"
11	12+10	"QUARRY"
[illegible]	12+[illegible]	STORAGE "A"
[illegible]	12+[illegible]	D.S. STORAGE
[illegible]	[illegible]	STORAGE "A"



11+00

TEST NO.	STATION	SOURCE OF MATERIAL
[illegible]	10+40	[illegible] STORAGE
[illegible]	10+60	" "
[illegible]	10+80	" "
[illegible]	10+[illegible]	" "
[illegible]	10+[illegible]	" "
[illegible]	11+00	" "

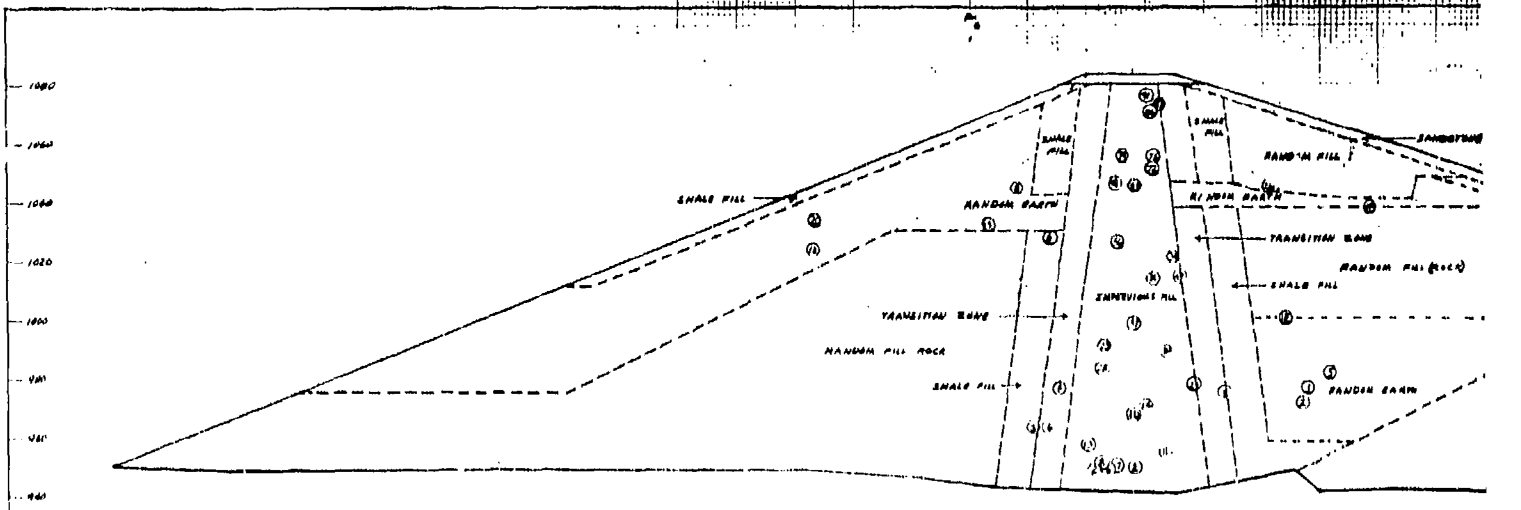
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

CARR FORK LAKE
DAM & SPILLWAY
COMPACTION TEST LOCATIONS
STA. 10+40 TO 12+27

1" = 20'
JAN 1977

2

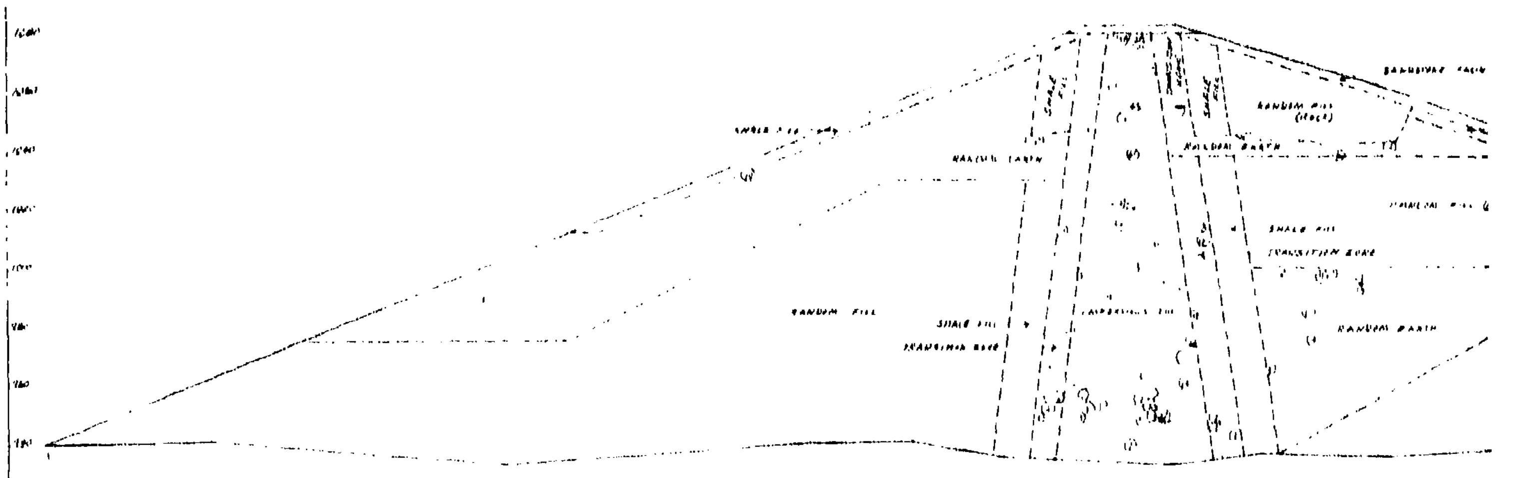
PLATE 14



14+00

TEST NO	STATION	SOURCE OF MATERIAL
5	[illegible]	QUARRY
7	[illegible]	STORAGE A
31	[illegible]	STORAGE A
47	13+60	STORAGE A
[illegible]	[illegible]	BORROW A
28	[illegible]	STORAGE A
[illegible]	[illegible]	U.S. STORAGE A
[illegible]	[illegible]	STORAGE A
6	[illegible]	STORAGE A
39	[illegible]	U.S. STORAGE
6	[illegible]	BORROW A
[illegible]	[illegible]	STORAGE A
8	14+00	QUARRY
[illegible]	[illegible]	STORAGE [illegible]
[illegible]	[illegible]	STORAGE [illegible]
17	[illegible]	ACCESS RD
26	[illegible]	STORAGE A
28	[illegible]	U.S. STORAGE
37	[illegible]	STORAGE A
41	[illegible]	U.S. STORAGE [illegible]
[illegible]	[illegible]	[illegible]

TEST NO	STATION	SOURCE OF MATERIAL
[illegible]	14+13	STORAGE A
63	14+20	U.S. STORAGE
12	14+25	BORROW A
[illegible]	[illegible]	STORAGE U A
24	[illegible]	STORAGE A
19	14+30	STORAGE A
[illegible]	14+32	STORAGE A
2	[illegible]	STORAGE A
28	14+37	STORAGE A
9	[illegible]	QUARRY
14	[illegible]	QUARRY
[illegible]	14+40	U.S. STORAGE
6	[illegible]	QUARRY
14	[illegible]	STORAGE A
8	[illegible]	U.S. STORAGE
13	[illegible]	ACCESS RD
16	[illegible]	BORROW A
20	[illegible]	BORROW A
41	[illegible]	U.S. STORAGE A
46	[illegible]	U.S. STORAGE A
36	[illegible]	STORAGE A



TEST NO	STATION	SOURCE OF MATERIAL
[illegible]	[illegible]	STORAGE A
8	[illegible]	QUARRY
[illegible]	[illegible]	QUARRY
2	[illegible]	QUARRY
4	[illegible]	QUARRY
1	[illegible]	STORAGE A
9	[illegible]	STORAGE A
[illegible]	[illegible]	QUARRY
12	[illegible]	STORAGE A
48	[illegible]	STORAGE A

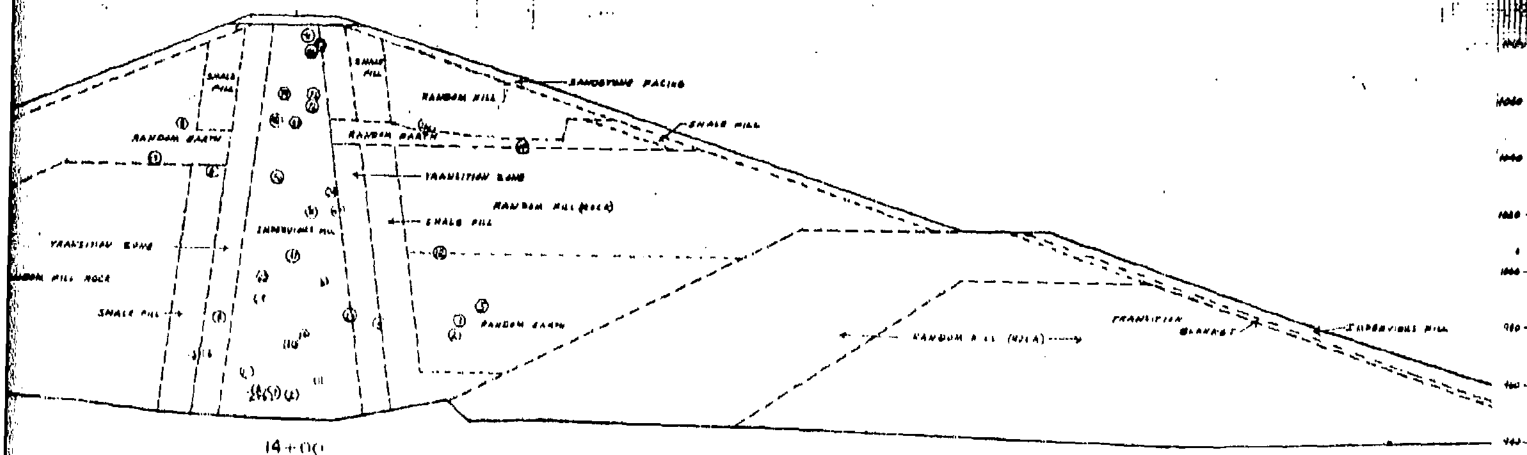
TEST NO	STATION	SOURCE OF MATERIAL
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	QUARRY
16	[illegible]	QUARRY
[illegible]	[illegible]	U.S. STORAGE
56A	[illegible]	U.S. STORAGE
[illegible]	[illegible]	STORAGE A
41	[illegible]	STORAGE A
[illegible]	[illegible]	U.S. STORAGE
[illegible]	[illegible]	QUARRY

TEST NO	STATION	SOURCE OF MATERIAL
[illegible]	[illegible]	STORAGE A
11	[illegible]	QUARRY
[illegible]	[illegible]	U.S. STORAGE
[illegible]	[illegible]	BORROW A
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	QUARRY
91	[illegible]	STORAGE A
49	[illegible]	-
[illegible]	[illegible]	STORAGE

12+90

TEST NO	STATION	SOURCE MATERIAL
1	[illegible]	QUARRY
9	[illegible]	STORAGE A
[illegible]	[illegible]	QUARRY
1	[illegible]	STORAGE A
47	[illegible]	STORAGE A

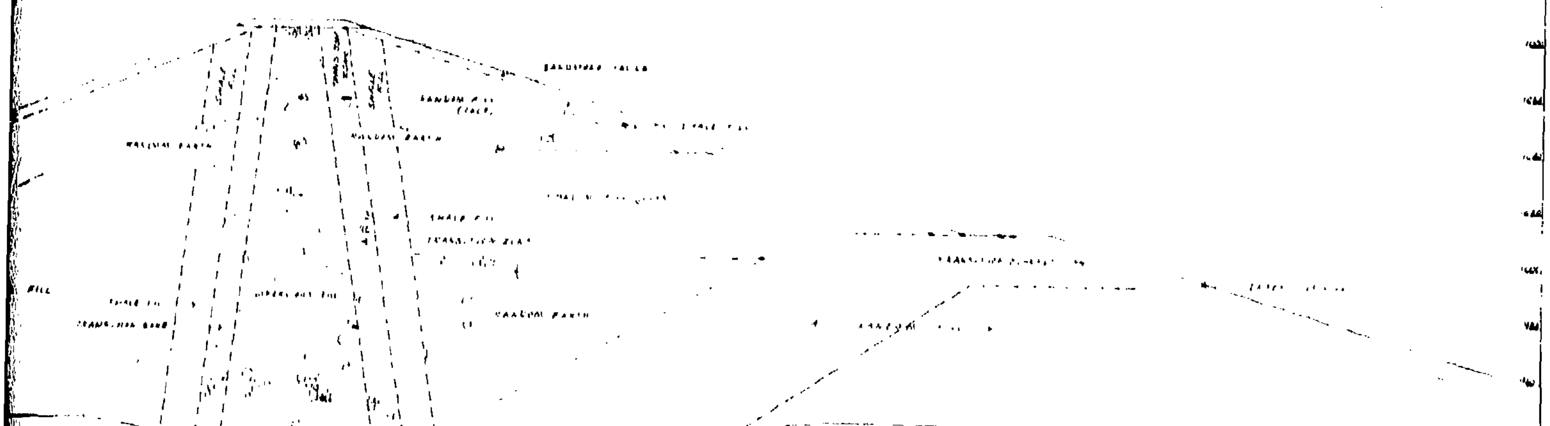
TEST NO	STATION	SOURCE [illegible]
5	13+00	BORROW [illegible]
[illegible]	[illegible]	BORROW [illegible]
14	[illegible]	BORROW [illegible]
43	[illegible]	STORAGE [illegible]
38	[illegible]	"
80	[illegible]	"
[illegible]	[illegible]	
9	[illegible]	U.S. [illegible]
[illegible]	[illegible]	U.S. [illegible]
8	[illegible]	QUAR[illegible]
[illegible]	[illegible]	U.S. [illegible]
[illegible]	[illegible]	STORA[illegible]



14+00

TEST NO	STATION	SOURCE OF MATERIAL
[illegible]	[illegible]	QUARRY
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	STORAGE A
17	[illegible]	STORAGE A
[illegible]	[illegible]	BORROW A
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	U.S. STORAGE A
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	U.S. STORAGE
[illegible]	[illegible]	BORROW A
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	QUARRY
[illegible]	[illegible]	STORAGE DA
[illegible]	[illegible]	STORAGE DA
[illegible]	[illegible]	ACCESS RD
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	U.S. STORAGE
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	U.S. STORAGE
[illegible]	[illegible]	STORAGE A

TEST NO	STATION	SOURCE OF MATERIAL
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	U.S. STORAGE
[illegible]	[illegible]	BORROW A
[illegible]	[illegible]	STORAGE DA
[illegible]	[illegible]	STORAGE A
19	14430	STORAGE A
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	QUARRY
[illegible]	[illegible]	QUARRY
[illegible]	[illegible]	U.S. STORAGE
[illegible]	[illegible]	QUARRY
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	U.S. STORAGE
[illegible]	[illegible]	ACCESS RD
16	[illegible]	BORROW A
[illegible]	[illegible]	BORROW A
[illegible]	[illegible]	U.S. STORAGE A
[illegible]	[illegible]	U.S. STORAGE A
[illegible]	[illegible]	STORAGE A



SOURCE OF MATERIAL
STORAGE A
QUARRY
U.S. STORAGE
BORROW A
STORAGE A
QUARRY
STORAGE A
STORAGE

TEST NO	STATION	SOURCE MATERIAL
[illegible]	[illegible]	QUARRY
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	QUARRY
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	STORAGE A

TEST NO	STATION	SOURCE MATERIAL
[illegible]	[illegible]	BORROW A
[illegible]	[illegible]	BORROW A
[illegible]	[illegible]	BORROW A
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	U.S. STORAGE
[illegible]	[illegible]	U.S. STORAGE
[illegible]	[illegible]	QUARRY
[illegible]	[illegible]	U.S. STORAGE
[illegible]	[illegible]	STORAGE A

TEST NO	STATION	SOURCE OF MATERIAL
[illegible]	[illegible]	AREA DA
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	U.S. STORAGE
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	STORAGE A
[illegible]	[illegible]	AREA DA

U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

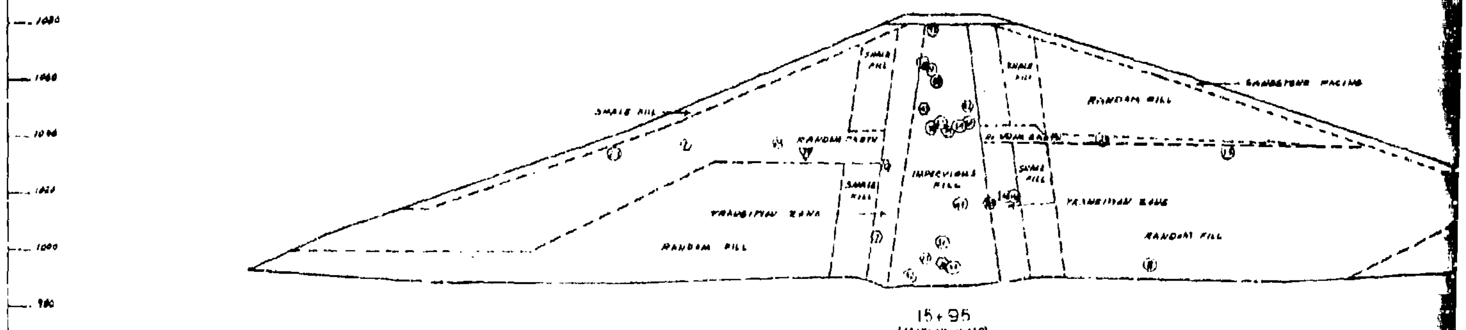
CARR FORK LAKE
DAM & SPILLWAY

COMPACTION TEST LOCATIONS
STA. 12+27 TO 14+50

SCALE 1" = 20'
DATE JAN 1977
DRAWING NUMBER

PLATE 15

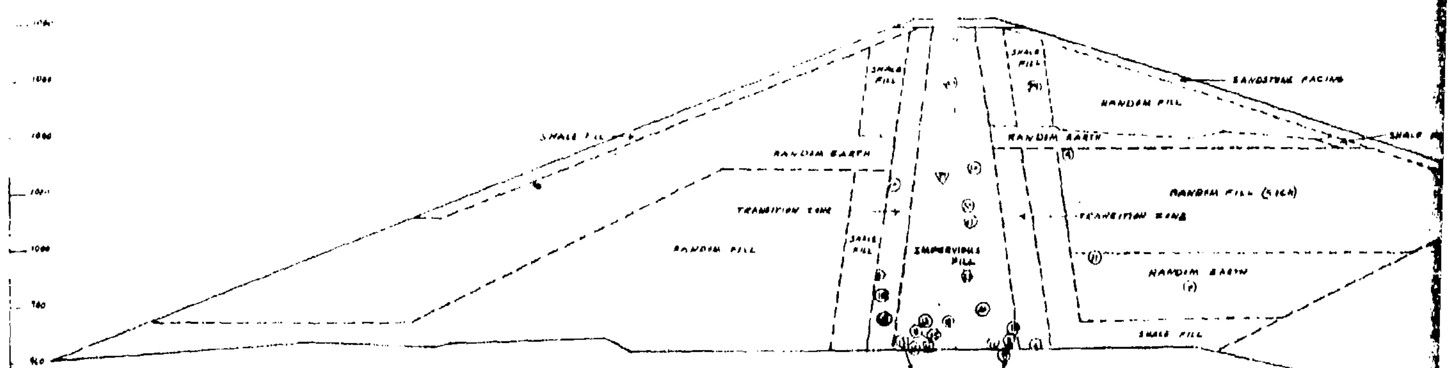
2



15+95
(15+51 TO 16+50)

TEST NO.	STATION	SOURCE OF MATERIAL
36	15+85	STORAGE "A"
22	15+90	STORAGE "A"
64	15+60	BORROW "A"
42	15+60	STORAGE "A"
43	15+61	D.S. STORAGE
24	15+35	STORAGE "A"
34	15+85	STORAGE "A"
70	[illegible]+85	D.S. STORAGE
21	15+98	ACCESS RD
10	16+00	"QUARRY"
	16+00	STORAGE "A"
9A	16+00	" "
23	16+00	" "
65	16+05	D.S. STORAGE
2	16+05	STORAGE "A"

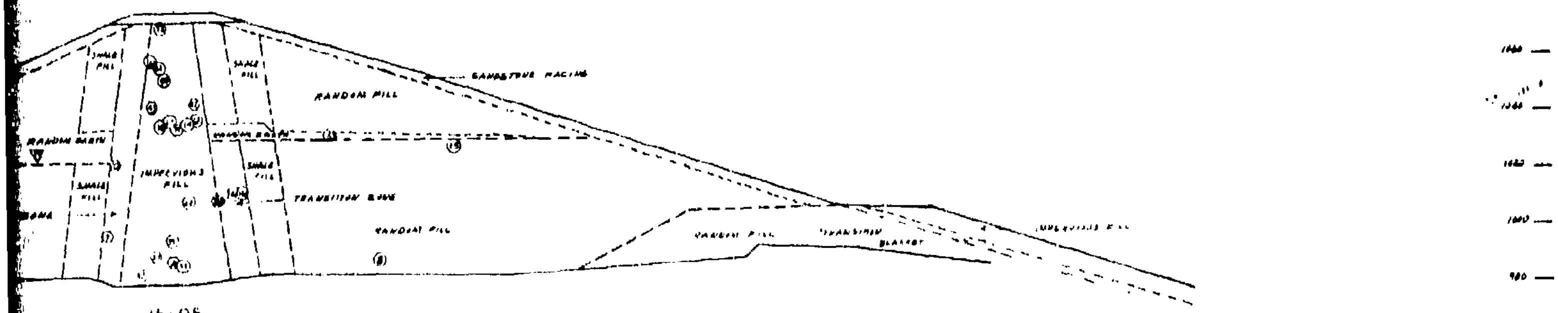
TEST NO.	STATION	SOURCE OF MATERIAL
6A	16+10	D.S. STORAGE
8	16+10	BORROW O.A.
69	16+30	D.S. STORAGE
65	16+35	D.S. STORAGE
19	16+40	"QUARRY"
34	16+40	STORAGE "A"
33	16+40	STORAGE "A"
7	16+41	"QUARRY"
26	16+41	STORAGE "A"
14	16+45	ACCESS RD
27	16+45	STORAGE "A"
18	16+48	ACCESS RD
67	[illegible]	D.S. STORAGE
43	[illegible]	D.S. STORAGE
30	[illegible]	"QUARRY"



14+95
(14+51 to 15+50)

TEST NO.	STATION	SOURCE OF MATERIAL
8	14+51	STORAGE "A"
17	14+56	STORAGE "A"
7	14+61	AREA "OA"
9	14+70	ACCESS RD
15	14+70	STORAGE "A"
33	[illegible]	STORAGE "A"
16	14+79	"QUARRY"
15	14+98	"QUARRY"
95	[illegible]	D.S. STORAGE
73	15+00	" "
45	15+00	" "
17	15+00	" "
[illegible]	15+07	"QUARRY"
[illegible]	[illegible]	" "
6	[illegible]	" "

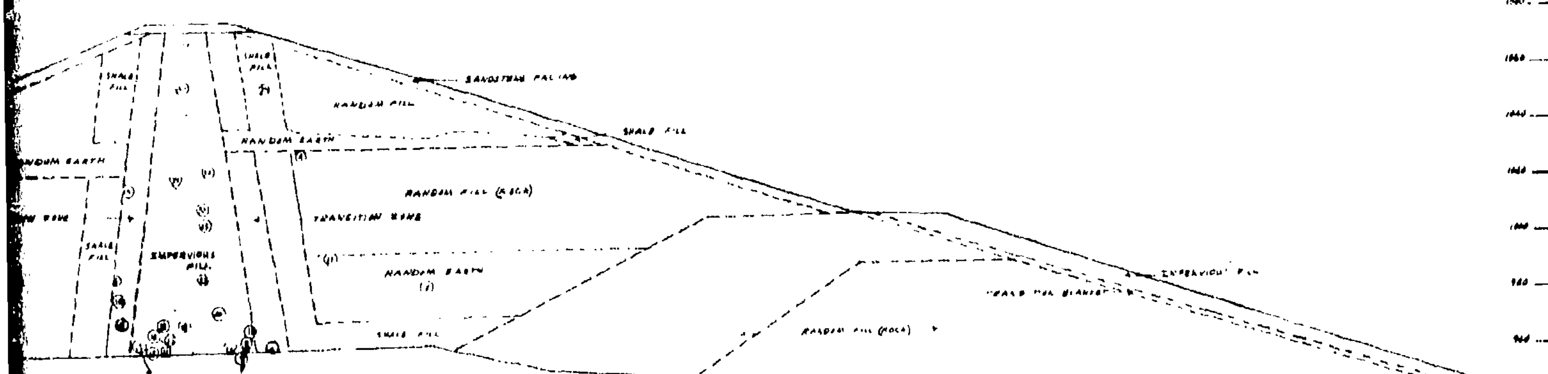
TEST NO.	STATION	SOURCE OF MATERIAL
11	15+10	STORAGE "A"
50	15+20	" "
72	15+22	" "
[illegible]	[illegible]	BORROW "A"
6	15+30	"QUARRY"
18	15+30	STORAGE "A"
22	15+40	STORAGE "A"
80	15+40	D.S. STORAGE
18	[illegible]	STORAGE "A"
18	[illegible]	STORAGE "A"
18	[illegible]	"QUARRY"
57	[illegible]	STORAGE "A"
10	[illegible]	"QUARRY"
[illegible]	[illegible]	STORAGE "A"



15+95
(15+51 TO 16+50)

SOURCE OF MATERIAL
STORAGE "A"
STORAGE "A"
BORROW "A"
STORAGE "A"
D.S. STORAGE
STORAGE "A"
STORAGE "A"
D.S. STORAGE
ACCESS RD
"QUARRY"
STORAGE "A"
" "
" "
D.S. STORAGE
STORAGE "A"

TEST NO	STATION	SOURCE OF MATERIAL
[illegible]	16+10	D.S. STORAGE
8	16+10	BORROW OA.
69	16+30	D.S. STORAGE
65	16+35	D.S. STORAGE
[illegible]	16+40	"QUARRY"
34	16+40	STORAGE "A"
33	16+40	STORAGE "A"
7	16+41	"QUARRY"
36	16+41	STORAGE "A"
14	16+45	ACCESS RD
27	16+45	STORAGE "A"
15	16+45	ACCESS RD
67	16+48	D.S. STORAGE
42	16+48	D.S. STORAGE
40	16+[illegible]	"QUARRY"



14+95
(14+51 TO 15+50)

SOURCE OF MATERIAL
STORAGE "A"
STORAGE "A"
AREA "OA"
ACCESS RD
STORAGE "A"
STORAGE "A"
"QUARRY"
"QUARRY"
D.S. STORAGE
" "
" "
" "
"QUARRY"
" "
" "

TEST NO	STATION	SOURCE OF MATERIAL
[illegible]	[illegible]	STORAGE "A"
50	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	BORROW A
6	[illegible]	"QUARRY"
[illegible]	[illegible]	STORAGE "A"
43	[illegible]	STORAGE "A"
[illegible]	[illegible]	D.S. STORAGE
[illegible]	[illegible]	STORAGE "A"
[illegible]	[illegible]	STORAGE "A"
[illegible]	[illegible]	"QUARRY"
[illegible]	[illegible]	STORAGE "A"
[illegible]	[illegible]	"QUARRY"
[illegible]	[illegible]	STORAGE "A"

U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

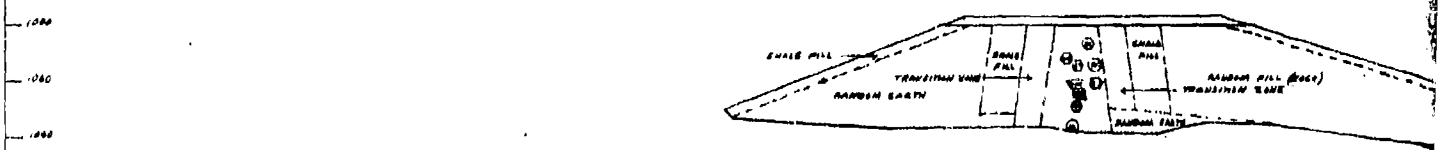
CARR FORK LAKE
DAM & SPILLWAY

COMPACTION TEST LOCATIONS
STA. 14+51 TO 16+50

DRAWN: CTS
SCALE: 1" = 20'
DATE: JAN 1977

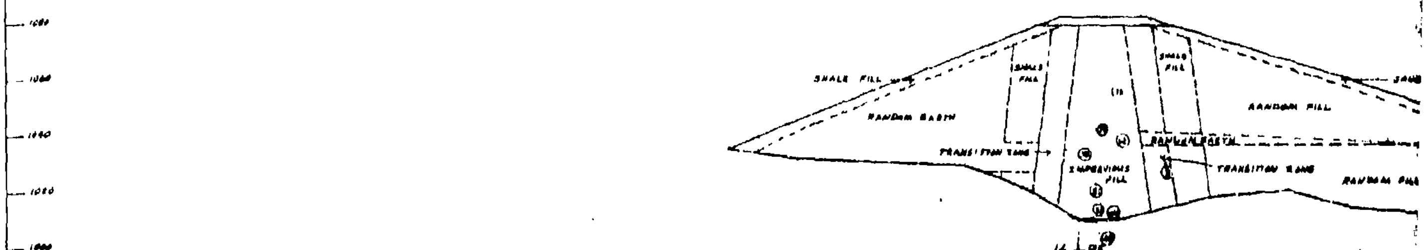
2

PLATE 16



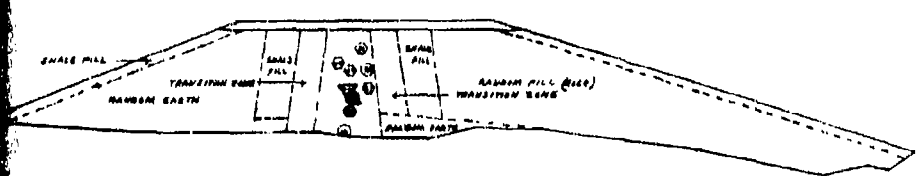
17 + 45
(17+21 TO 18+07)

TEST NO.	STATION	SOURCE OF MATERIAL
66	17+00	D. S. STORAGE
[illegible]	17+66	" "
84	17+83	" "
77B	17+85	" "
77A	17+86	" "
47	17+90	" "
49	17+98	" "
50	18+00	" "
[illegible]	[illegible]	" "



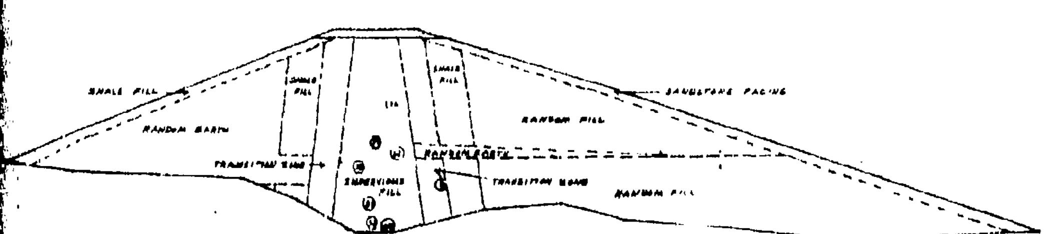
16 + 95
(16+45 TO 17+20)

TEST NO.	STATION	SOURCE OF MATERIAL
39	16+95	D. S. STORAGE
40	16+95	STORAGE "A"
46	16+95	STORAGE "A"
70	16+95	D. S. STORAGE
33	17+00	STORAGE "A"
38	17+05	STORAGE "A"
1	17+05	QUARRY
38	17+20	STORAGE [illegible]
[illegible]	17+38	[illegible]



17 + 45
(17+31 TO 18+07)

TEST NO.	STATION	SOURCE OF MATERIAL
46	17+40	D. S. STORAGE
[illegible]	17+44	" "
[illegible]	17+83	" "
[illegible]	[illegible]	" "
[illegible]	[illegible]	" "
[illegible]	[illegible]	" "
[illegible]	[illegible]	" "
[illegible]	[illegible]	" "
[illegible]	[illegible]	" "



16 + 95
(16+51 TO 17+30)

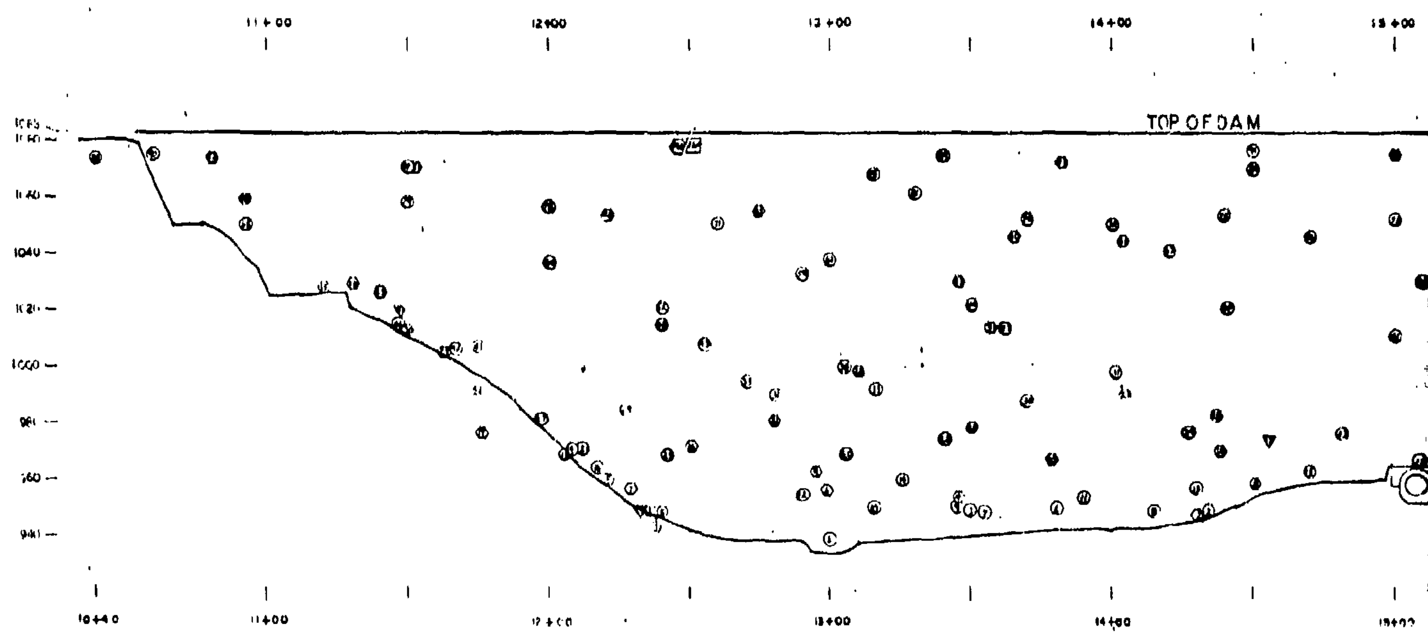
[illegible]	[illegible]	[illegible]
[illegible]	16+95	A. S. STORAGE
[illegible]	16+95	STORAGE "A"
[illegible]	16+95	STORAGE "A"
[illegible]	16+95	D. S. STORAGE
[illegible]	17+00	STORAGE "B"
3A	17+00	STORAGE "A"
1	17+05	QUARRY
[illegible]	17+20	STORAGE [illegible]
[illegible]	[illegible]	[illegible]

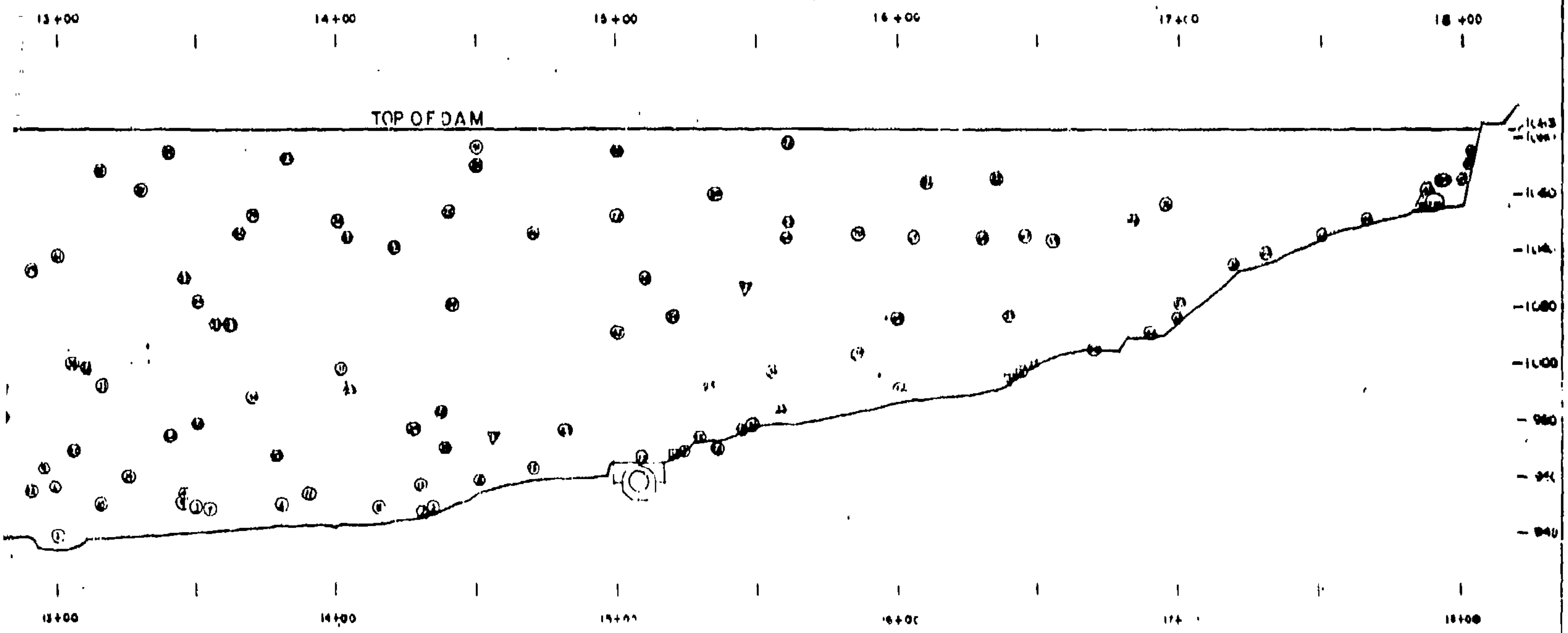
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

CARR FORK LAKE
DAM & SPILLWAY

COMPACTION TEST LOCATIONS
STA. 16+51 TO 18+07

PLATE 17


11+00
12+00
13+00
14+00
15+00
TOP OF DAM
1040
1000
10+40
11+00
12+00
13+00
14+00



LEGEND:
- GOVERNMENT TEST-PASSED
- GOVERNMENT TEST-FAILED
- CONTRACTOR TEST-PASSED
- CONTRACTOR TEST-FAILED

U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS

CARR FORK LAKE
DAM & SPILLWAY

℄ PROFILE OF DAM
IMPERVIOUS TESTS PLOTTED

MARCH 1977

PLATE 1

CONTRACTOR FIELD

MATERIAL (ZONE)	NUMBER OF TESTS	DRY DENSITY				PERCENT COMPACTI		
		HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AVERAGE
IMPERVIOUS	89 *	127.0	107.4	117.8	110.2	110.4	94.8	101.2
RANDOM	29 **	128.2	109.4	119.6	110.2	109.0	94.6	102.2
TRANSITION	20 ***	149.4	123.3	138.0	140.0	178.0	76.0	116.3

* OF THE 89 TESTS RUN ON THE IMPERVIOUS MATERIAL 7 TESTS
OPTIMUM AND 4 TESTS INDICATED THE MATERIAL WAS BELOW T
FAILED WERE REWORKED. ALL AREAS WERE RETESTED AND THE

** OF THE 29 TESTS RUN ON THE RANDOM MATERIAL ONLY 1 TEST FAI
BELOW THE COMPACTION DESIRED). THIS AREA WAS REWORKED A

*** OF THE 20 TESTS RUN ON THE TRANSITION MATERIAL ONLY
DESIRED). THIS AREA WAS REWORKED AND RETESTED AND T

CORPS OF ENGINEER

MATERIAL (ZONE)	NUMBER OF TESTS	DRY DENSITY				PERCENT COMPACT		
		HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AVERAGE
IMPERVIOUS	53 *	123.3	104.5	116.3	110.2	105.5	90.8	99.4
RANDOM	8 **	126.8	115.5	120.0	110.2	102.7	96.6	100.1
TRANSITION	11 ***	146.4	127.7	137.1	140.0	148.0	86.8	115.9

* OF THE 53 TESTS RUN ON THE IMPERVIOUS MATERIAL 3 TESTS
OPTIMUM AND 2 TESTS INDICATED THE MATERIAL WAS BELOW T
FAILED WERE REWORKED. THERE WAS 1 AREA THAT WAS RE

** OF THE 8 TESTS RUN ON THE RANDOM MATERIAL 0 TESTS

*** OF THE 11 TESTS RUN ON THE TRANSITION MATERIAL OT

(1) STANDARD PROCTOR TEST USED ON THE IMPERVIOUS AND RANDOM MATERI
(2) NOT APPLICABLE - NO MOISTURE CONTROL SPECIFIED
(3) INDICATE RESULTS OF ALL TESTS FOR HIGH AND LOW VALUES AND INDICATE RESULTS OF

APP F-K

FIELD COMPACTION CONTROL - DAM

OMPACTION ① ③		WATER CONTENT ③				DEVIATION FROM OPTIMUM ③			
VERAGE	DESIRED	HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AVERAGE	SPECIFIED
101.2	95.0	17.4	11.0	14.3	13.4	+2.5	-1.7	-.58	-2.0 +2.0
102.2	95.0	19.9	11.0	14.0	13.4	+2.1	-2.8	-.40	-2.0 +3.0
116.3	85.0	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②

TESTS FAILED (3 TESTS INDICATED THE MATERIAL WAS TOO WET OF
LOW THE COMPACTION DESIRED). ALL OF THE TEST SECTIONS THAT
ND THE TESTS WERE ACCEPTABLE.

EST FAILED (THE MATERIAL WAS BOTH TOO DRY OF OPTIMUM AND
RKED AND RETESTED AND THE TEST WAS ACCEPTABLE.

ONLY 1 TEST FAILED (THE MATERIAL WAS BELOW THE COMPACTION
AND THE TEST WAS ACCEPTABLE.

NGINEERS ACCEPTANCE TESTS - DAM

COMPACTION ① ③		WATER CONTENT ③				DEVIATION FROM OPTIMUM ③			
VERAGE	DESIRED	HIGH	LOW	AVERAGE	DESIGN	HIGH	LOW	AVERAGE	SPECIFIED
99.4	95.0	17.6	11.6	14.1	13.4	+2.0	-2.1	-.32	-2.0 +2.0
100.1	95.0	14.9	10.4	13.9	13.4	+0.7	-2.0	-.46	-2.0 +3.0
115.9	85.0	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②	N/A ②

TESTS FAILED (1 TEST INDICATED THE MATERIAL WAS TOO DRY OF
LOW THE COMPACTION DESIRED). ALL OF THE TEST SECTIONS THAT
WAS RETESTED AND THIS TEST WAS ACCEPTABLE.

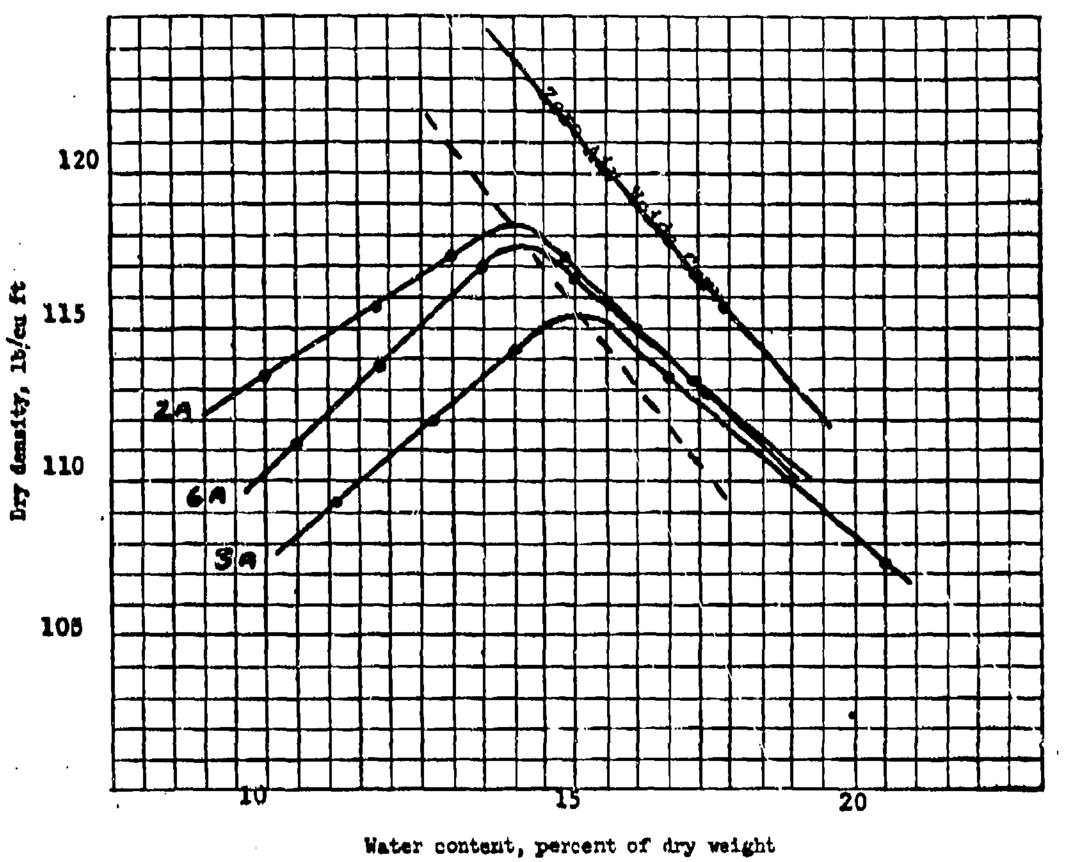
TESTS FAILED.

L OTESTS FAILED.

MATERIAL , RELATIVE DENSITY TEST USED ON THE TRANSITION MATERIAL

SULTS OF ACCEPTABLE TESTS AND RETESTS FOR AVERAGE VALUES.

PLATE 19



Standard compaction test

56 blows per each of 3 layers, with 5.5 lb rammer and

12 inch drop. 6 inch diameter mold

Sample No.	Elev or Depth	Classification	G	LL	PL	% > No. 4	% > 3/4 in.
2A	18"	Gravelly sandy clay SC-SM	2.75	27.0	20.3	26.4	10.1
3A	970±	Gravelly sandyclay SC	2.72	28.8	20.5	17.[illegible]	3.2
6A	3'	Gravelly sandyclay SC-SM	2.73	27.3	20.6	26.0	9.5

Sample No.	2A	3A	6A	
Natural water content, percent				
Optimum water content, percent	14.0	15.2	14.2	
Max dry density, lb/cu ft	118.3	115.5	117.7	

Remarks Material for use in impervious core

Project Carr Fork Lake Dam & Spillway
Vicco, Ky.

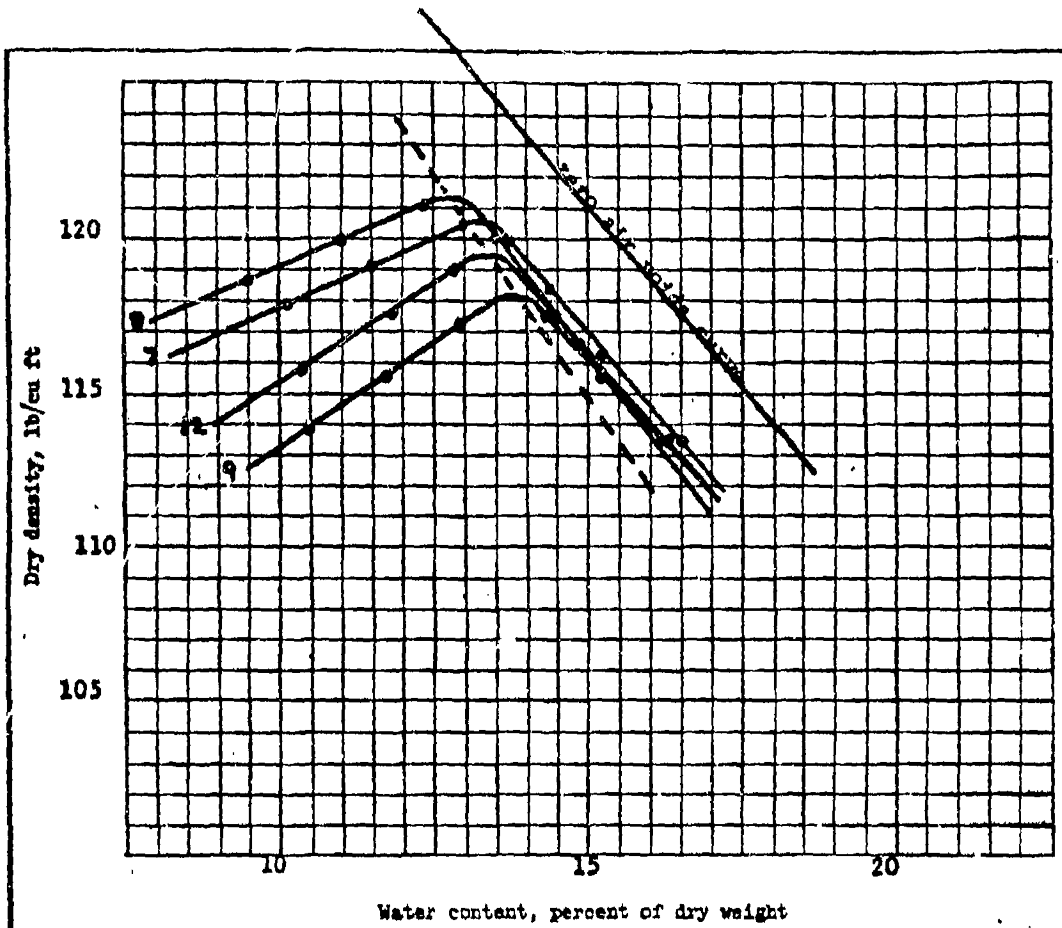
Area Storage Area "A"

Boring No.

Date May 1973

COMPACTION TEST REPORT

ENG FORM 2091, 1 JUN 65 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)



Standard compaction test

56 blows per each of 3 layers, with 5.5 lb rammer and

12 inch drop. 6 inch diameter mold

Sample No.	Elev or Depth	Classification	G	LL	PL	% > No. 4	% > 3/4 in.
7DS		Gravelly sandy clay, SC-SM	2.73	24.2	19.0	24.4	14.4
8DS		Sandy gravelly clay, GC-GM	2.72	26.4	19.7	33.4	16.5
9DS		Gravelly clayey sand, SC-SM	2.75	23.9	19.6	14.7	4.2
10DS		Gravelly clayey sand, SC-SM	2.70	23.2	18.4	21.9	5.9

Sample No.	10	9	8	7
Natural water content, percent				
Optimum water content, percent	13.3	13.8	12.8	13.3
Max dry density, lb/cu ft	119.2	118.2	121.3	120.6

Remarks For use in impervious core.

Project Carr Fork Lake Dam and Spillway

Vicco, Ky.

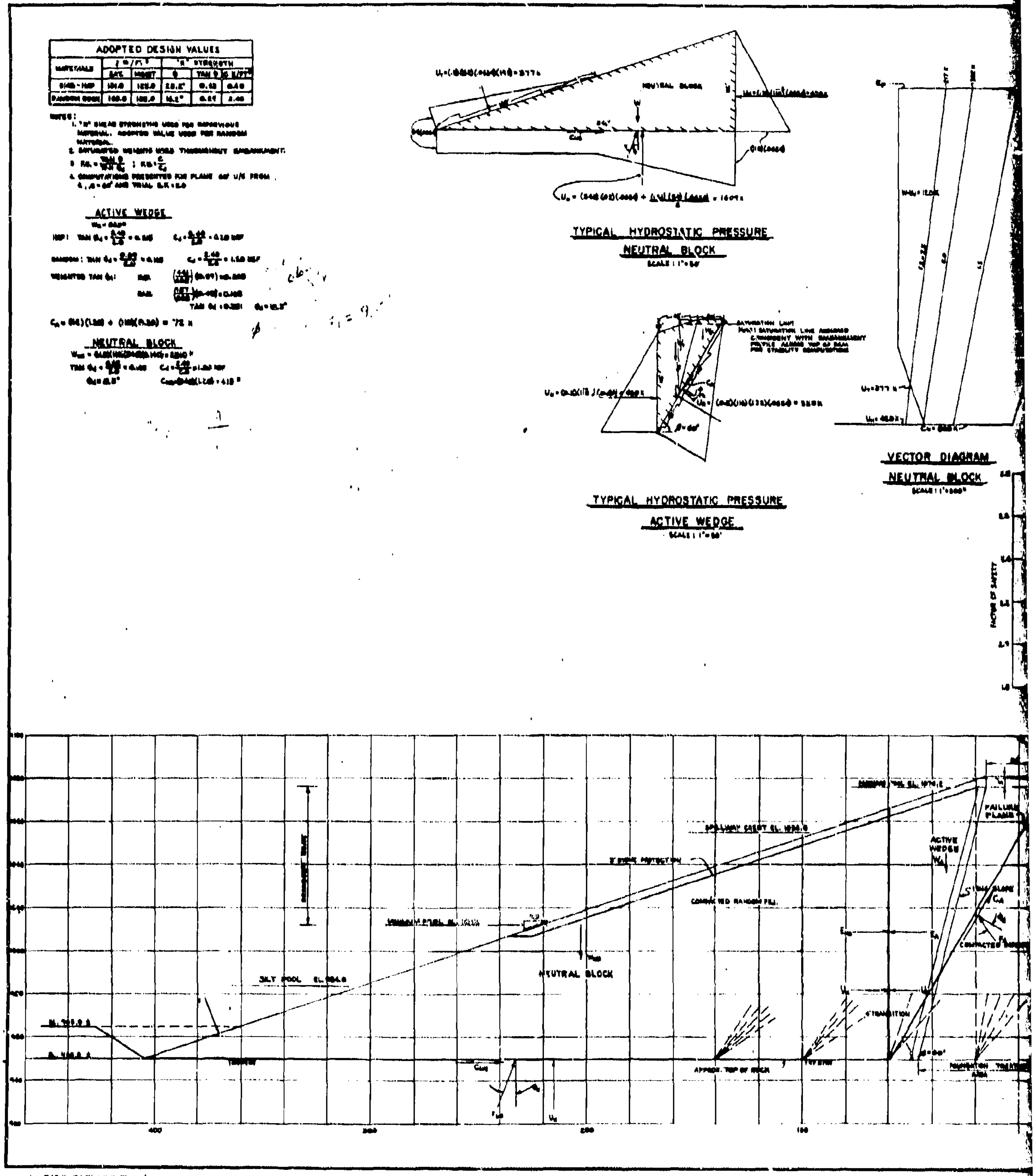
Area D.S. storage area

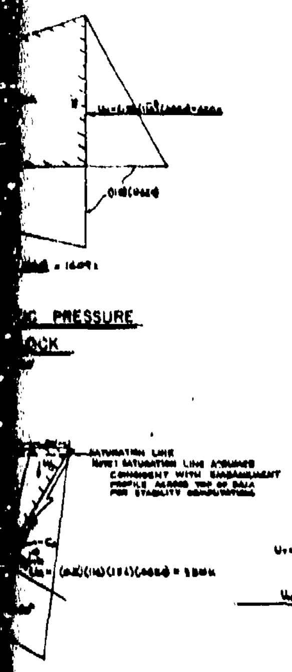
Boring No.

Date 24 Aug 73

COMPACTION TEST REPORT

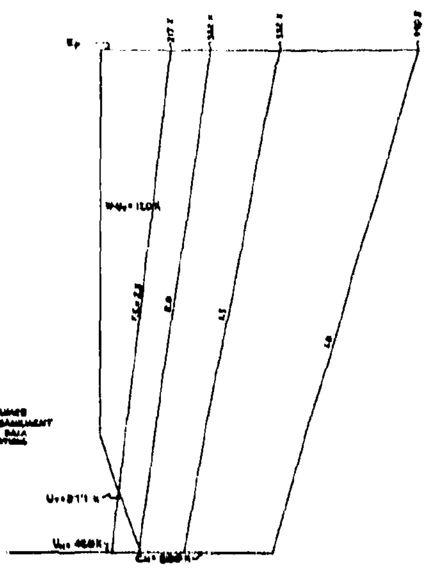
ENG FORM 1 JUN 65 2091 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)


ADOPTED DESIGN VALUES
NOTES:
ACTIVE WEDGE
NEUTRAL BLOCK
TYPICAL HYDROSTATIC PRESSURE
NEUTRAL BLOCK
TYPICAL HYDROSTATIC PRESSURE
ACTIVE WEDGE
VECTOR DIAGRAM
NEUTRAL BLOCK
NEUTRAL BLOCK
SILT POOL
COMPACTED RANDOM FILL
ACTIVE WEDGE
FAILURE PLANE
APPROX. TOP OF ROCK
TRANSITION
FACTOR OF SAFETY
400
300
200
100

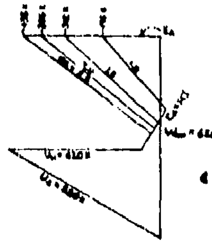


...IC PRESSURE
...OCK

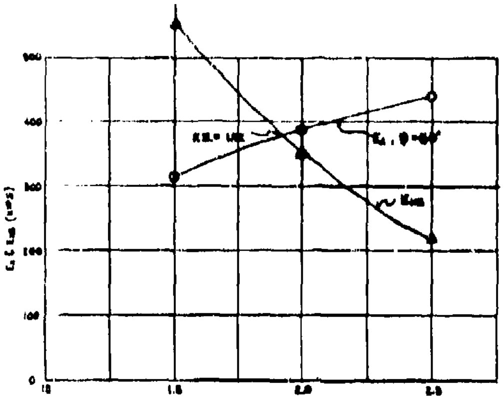
...TATIC PRESSURE
... WEDGE

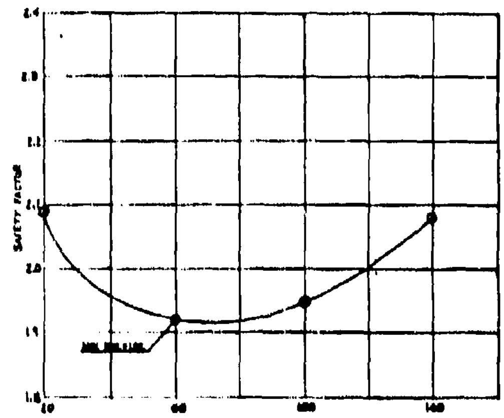


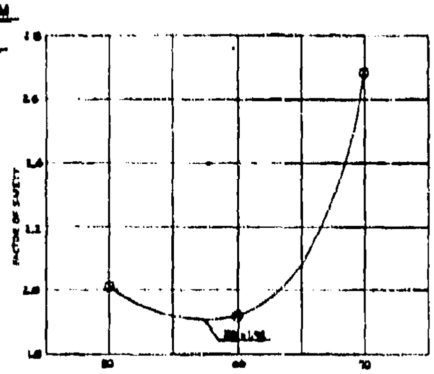
VECTOR DIAGRAM
NEUTRAL BLOCK

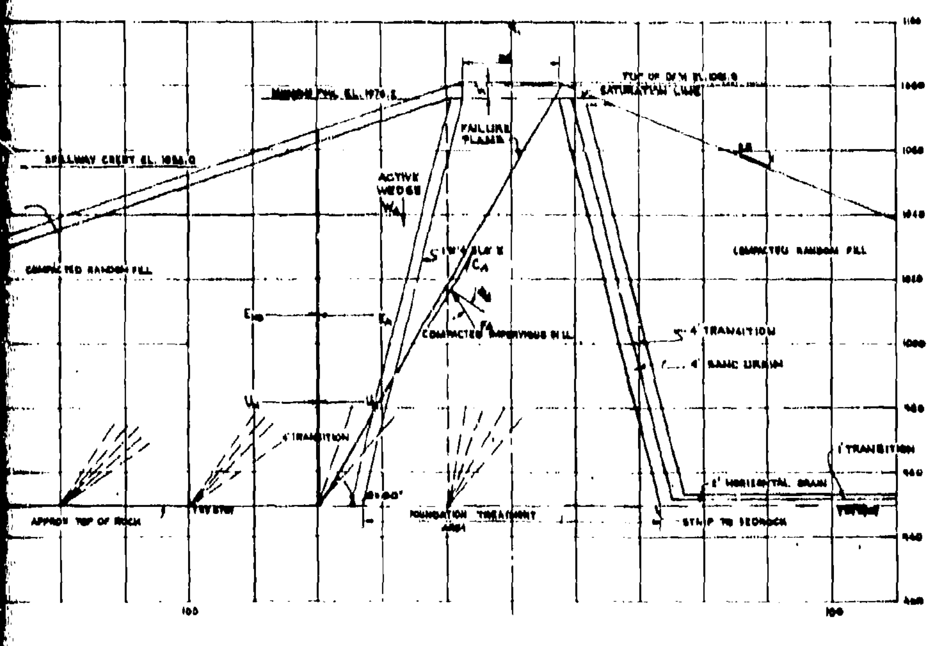


VECTOR DIAGRAM
ACTIVE WEDGE









U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

KENTUCKY RIVER BASIN, KY.
CARR FORK RESERVOIR

STABILITY ANALYSIS
SUDDEN DRAWDOWN
SHEET 1

SCALE: AS SHOWN

2

ADOPTED DESIGN VALUES					
MATERIALS	γ LB/FT³		"R" STRENGTH		
	SAT.	MOIST	φ	TAN φ	C T/FT²
EMB - IMP	131.0	125.0	23° 18'	0.43	0.20
RANDOM ROCK	140.0	135.9	16°	0.29	1.20

NOTES:

1. "R" SHEAR STRENGTHS USED FOR IMPERVIOUS MATERIAL.
2. SATURATED WEIGHTS USED BELOW SPILLWAY CREST
3. $F.S. = \frac{TAN\ \phi}{TAN\ \phi_d}$; $F.S. = \frac{C}{C_d}$
4. COMPUTATIONS PRESENTED FOR PLANE WT' U/S FROM, Φ, β=30° AND TRIAL S.F.=1.5

ACTIVE WEDGE

$W_A = 984^K$

IMP: $TAN\ \phi_d = \frac{0.43}{1.5} = 0.29$

RANDOM: $TAN\ \phi_d = \frac{0.29}{1.5} = 0.20$

WEIGHTED $TAN\ \phi_d$: IMP. [illegible] (0.29) = .046

RAN. [illegible] (0.20) = .168

$TAN\ \phi_d = 0.214$ $\phi_d = 12°$

$C_A = $ [illegible] $= 1 [illegible]^K$

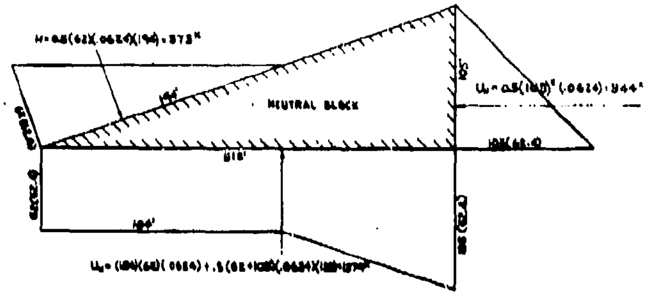
NEUTRAL BLOCK

$W_{NB} = $ [illegible]

$TAN\ \phi_d = \frac{0.29}{1.5} = 0.20$

$\phi_d = 12°$

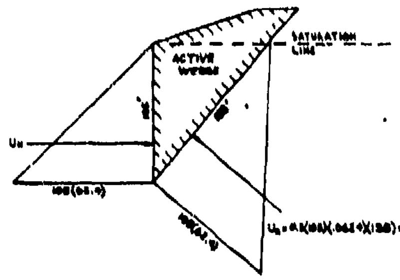
$C_{NB} = $ [illegible] $(312) = 303^K$



TYPICAL HYDROSTATIC PRESSURE

NEUTRAL BLOCK

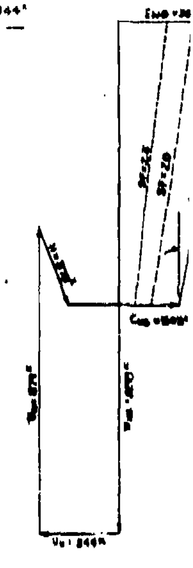
SCALE: 1" = 50'



TYPICAL HYDROSTATIC PRESSURE

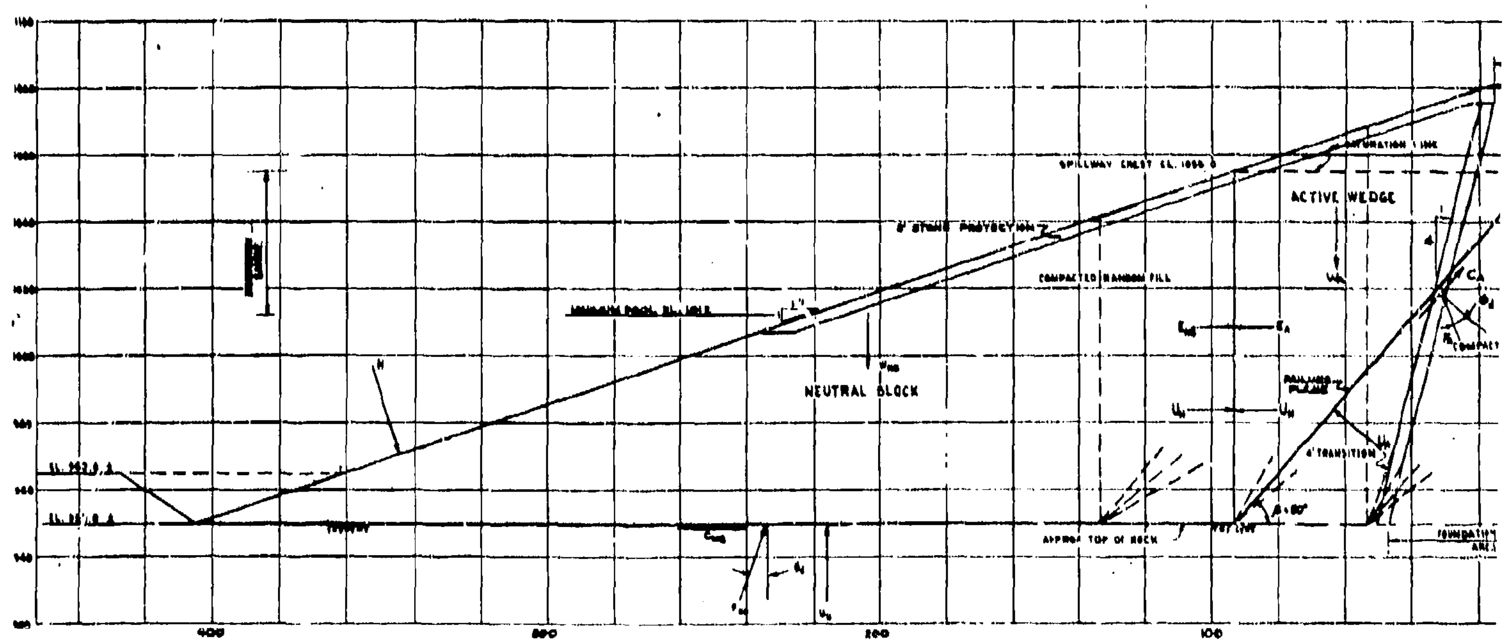
ACTIVE WEDGE

SCALE: 1" = 50'

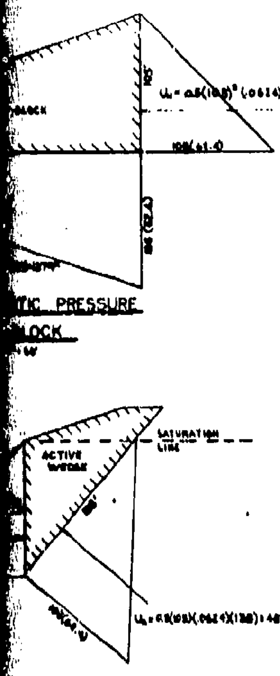


VECTOR DIAGRAM

NEUTRAL BLOCK

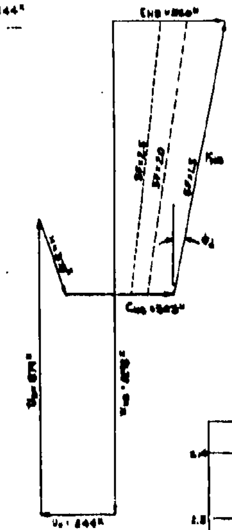


U.S. ARMY

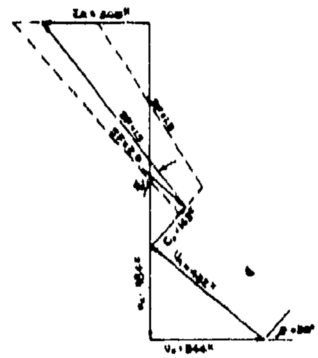


TIC PRESSURE
LOCK

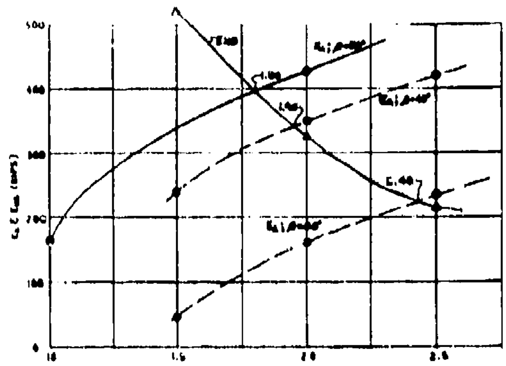
TATIC PRESSURE
E WEDGE



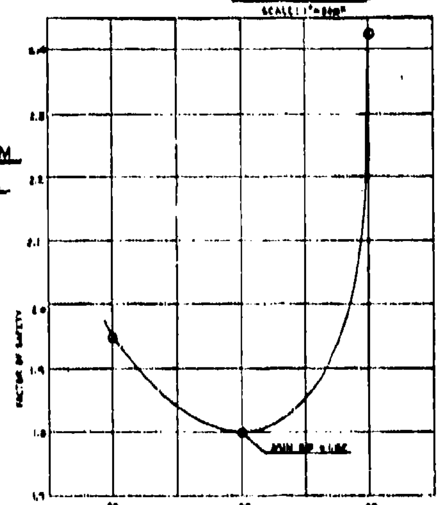
VECTOR DIAGRAM
NEUTRAL BLOCK



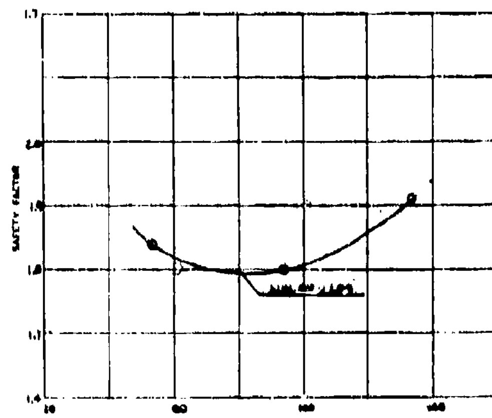
VECTOR DIAGRAM
ACTIVE WEDGE



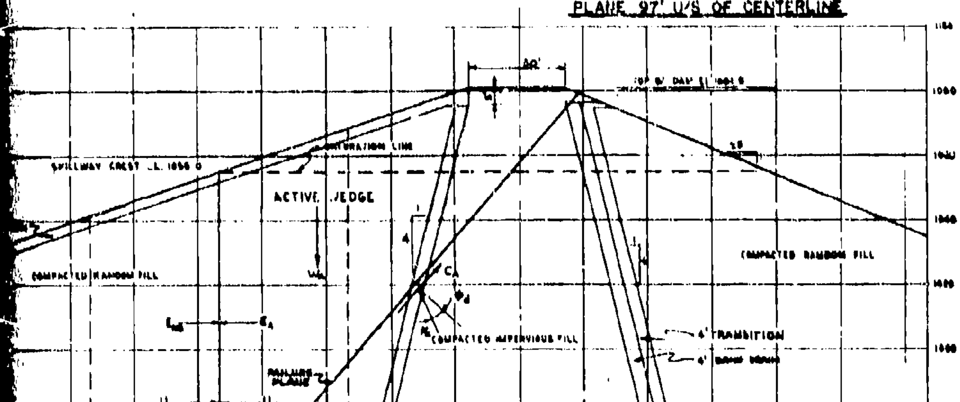
TRIAL FACTOR OF SAFETY
PLANE 97' U/S OF CENTERLINE



β ANGLE
PLANE 97' U/S OF CENTERLINE



DISTANCE U/S OF CENTERLINE



U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

KENTUCKY RIVER BASIN, KY.
CARR FORK RESERVOIR

STABILITY ANALYSIS
SUDDEN DRAWDOWN

JUNE 1965

SCALE AS SHOWN

PLATE 83

ADOPTED DESIGN VALUES					
MATERIAL	γ #/FT³		Q STRENGTH		
	MOIST	SUB	φ	TAN φ	C T/FT²
EMB.	125.0	62.5	0°	0.00	0.70
ROCK	135.0	77.5	[illegible]	0.65	0.00

NOTES:

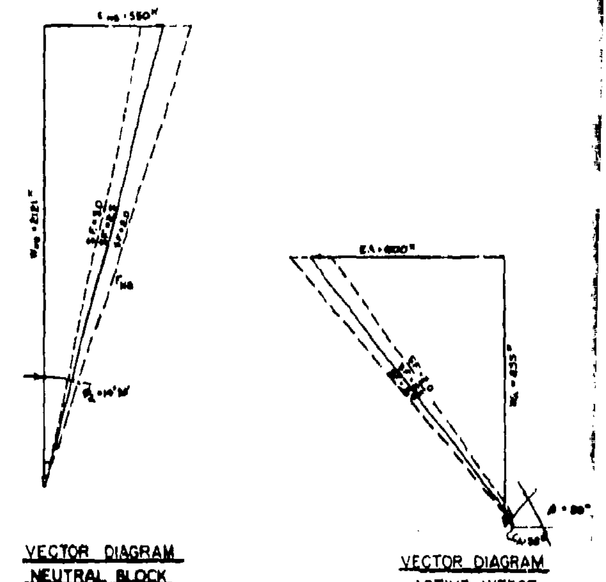
1. "Q" STRENGTH USED
2. F.S. = [illegible] ; F.S. = [illegible]
3. COMPUTATIONS PRESENTED FOR PLANE 400' U/S FROM ℄ DAM, β = [illegible] AND TRIAL S.F. = [illegible]

ACTIVE WEDGE

[illegible]

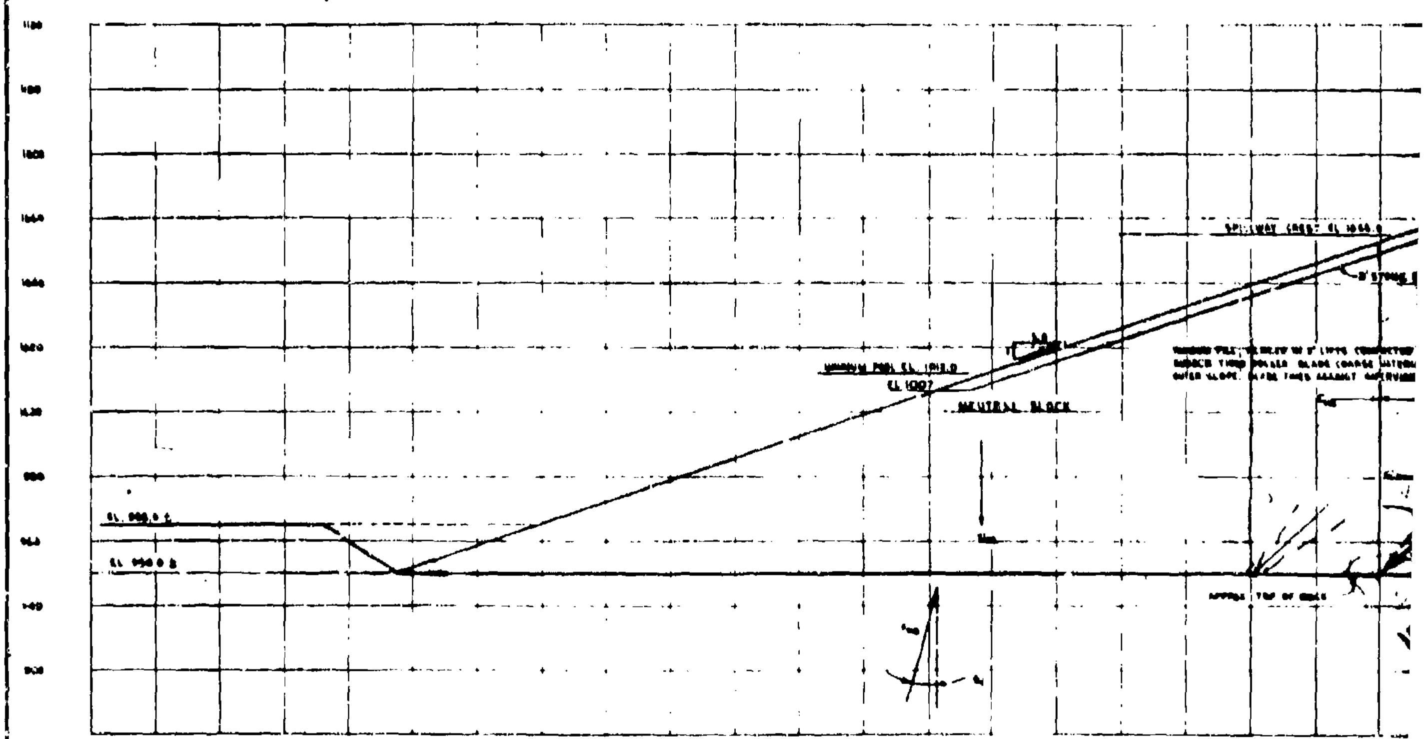
NEUTRAL BLOCK

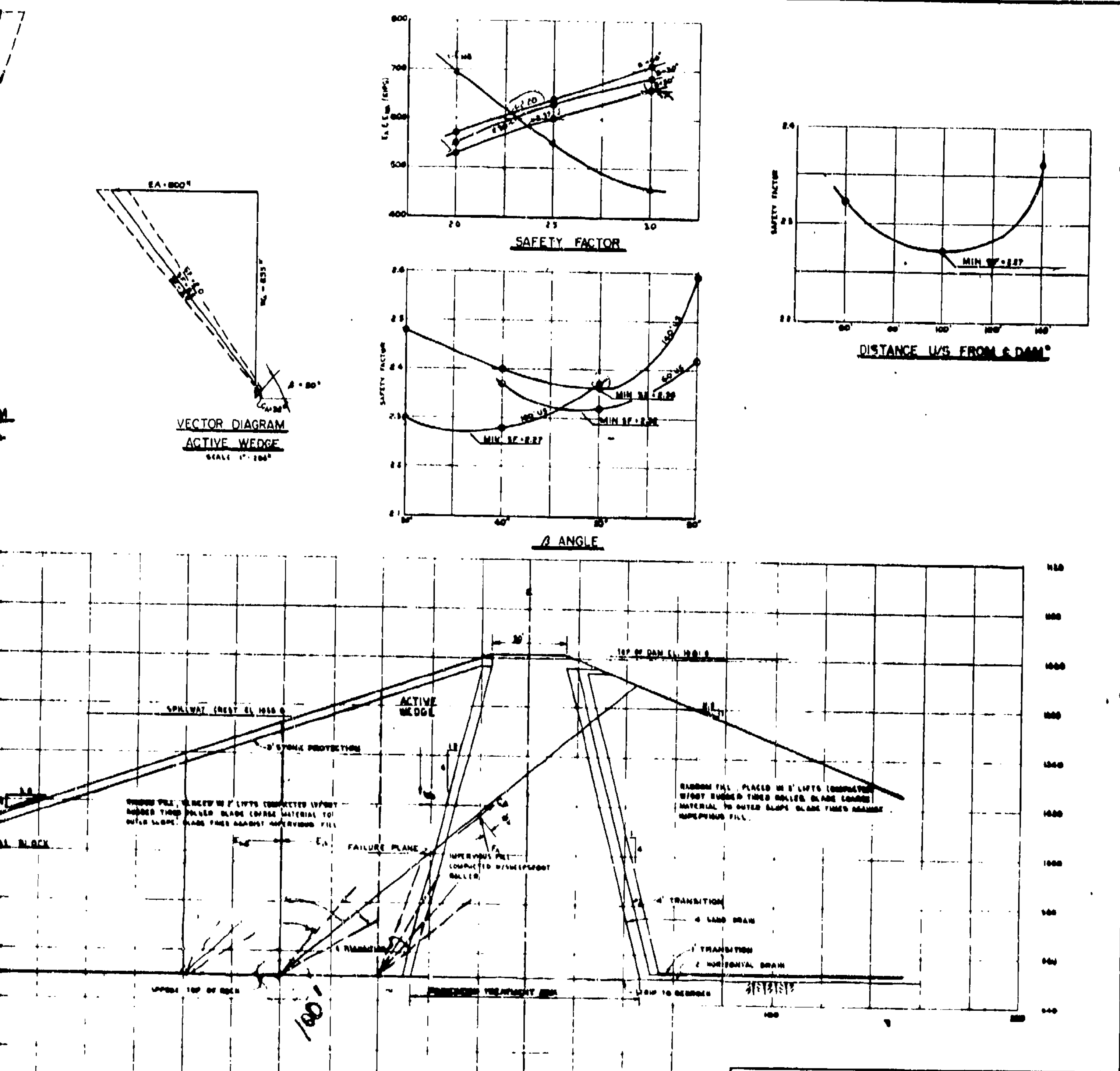
[illegible]



VECTOR DIAGRAM NEUTRAL BLOCK

VECTOR DIAGRAM ACTIVE WEDGE





U. S. ARMY ENGINEER DISTRICT, LOUISVILLE

CORPS OF ENGINEERS

KENTUCKY RIVER BASIN, KY.

CARR FORK RESERVOIR

UPSTREAM DAM SECTION

STABILITY ANALYSIS

END OF CONSTRUCTION

PLATE 24

ADOPTED DESIGN VALUE						
MATERIAL	γ lb/ft³			STRENGTH		
	MOIST	SAT.	SUB	TEST	TAN φ	C T/FT²
IMP. EMB.	[illegible]	[illegible]	[illegible]	Q	0.00	0.70
RANDOM ROCK	[illegible]	140.0	77.5	Q	[illegible]	0.00

NOTES:

1. "Q" SHEAR STRENGTHS USED
2. $F.S. = \frac{TAN\ \phi}{TAN\ \phi_d}$; $F.S. = \frac{C}{C_d}$
3. COMPUTATIONS PRESENTED FOR PLANE 80' D.S. FROM ℄ DAM, $\beta = 40°$ AND TRIAL F.S. = 2.0

ACTIVE WEDGE

$W_A = 1209^K$

$C_A = \frac{1.4}{1.5}(60) = 57^K$

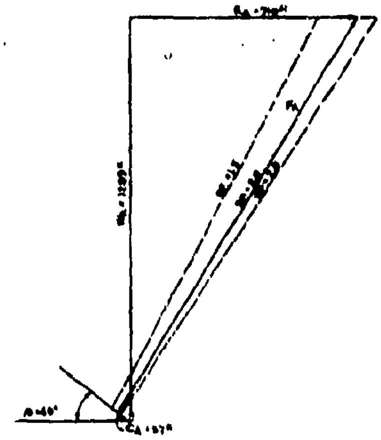
WEIGHTED TAN φ = [illegible]

TAN ϕ_d = [illegible]

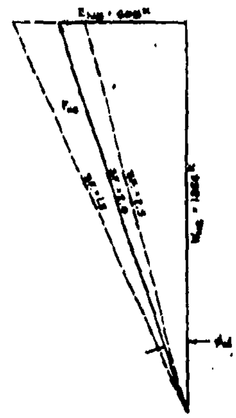
NEUTRAL BLOCK

W_{NB} = [illegible] = 1064^K

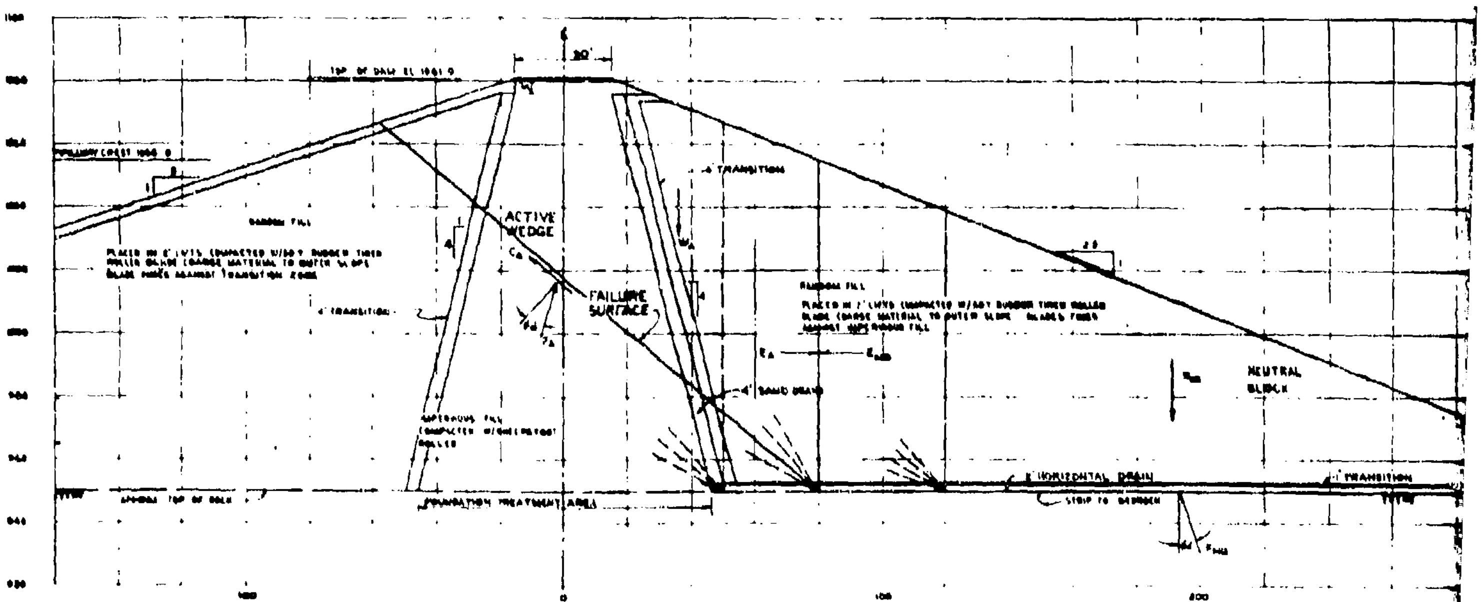
TAN ϕ_d = [illegible] $\phi_d = 18°$

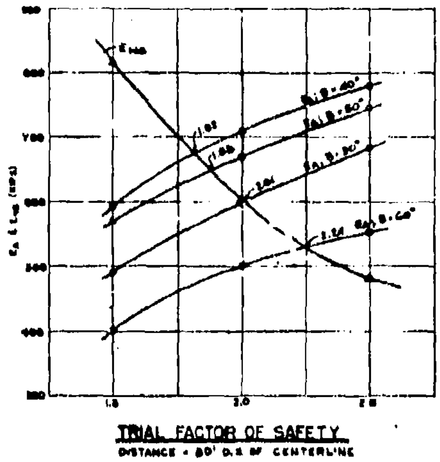


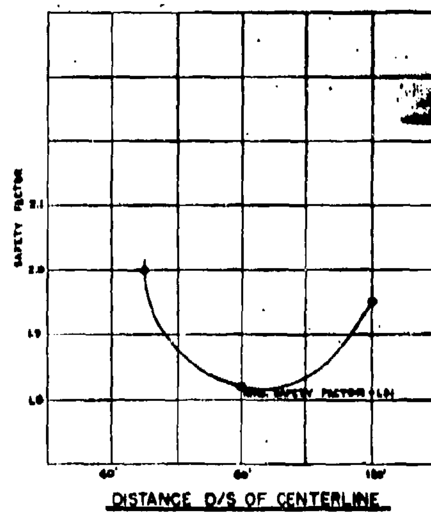
VECTOR DIAGRAM
ACTIVE WEDGE
SCALE: 1" = 200 K

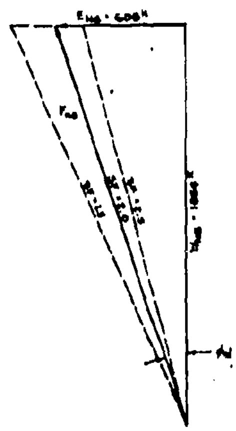


VECTOR DIAGRAM
NEUTRAL BLOCK
SCALE: 1" = 200 K

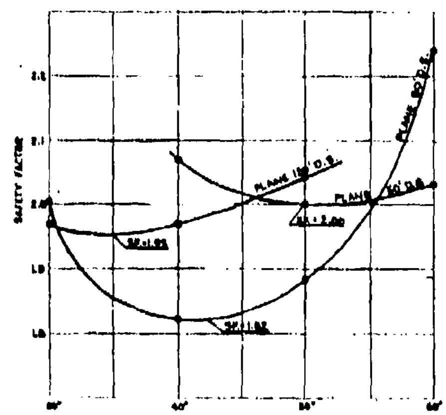


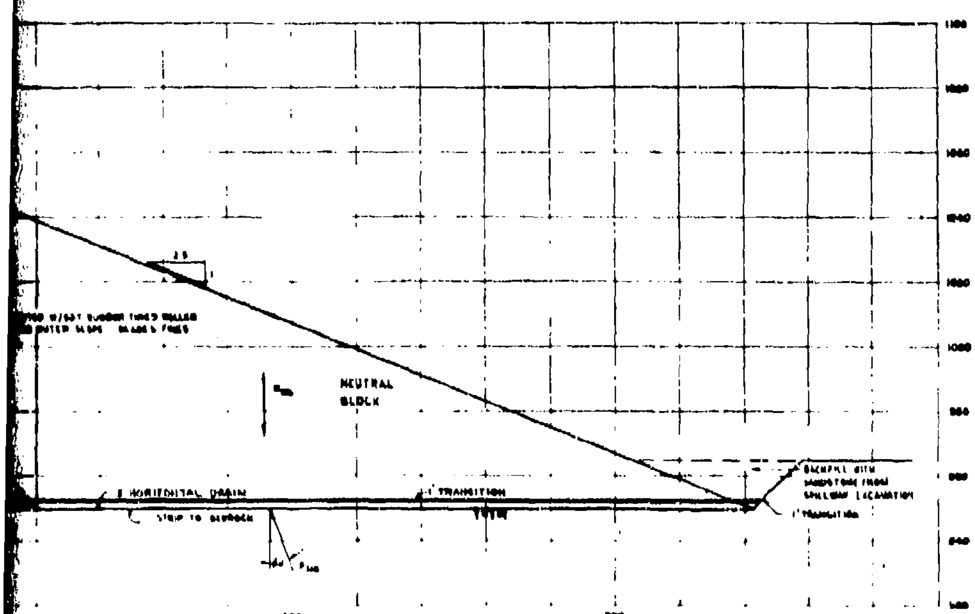






VECTOR DIAGRAM
NEUTRAL BLOCK





REVISION	DATE	DESCRIPTION	BY

U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS

KENTUCKY RIVER BASIN, KY
CARR FORK RESERVOIR
DOWNSTREAM DAM SECTION
STABILITY ANALYSIS
END OF CONSTRUCTION

TRACED: RSC
CHECKED: G.H.
JUNE 19[illegible]

ADOPTED DESIGN VALUES						
MATERIAL	WT #/FT³			STRENGTH		
	MOIST	SAT	SUB	TEST	TAN φ	C T/FT²
IMP EMB	125.0	131.0	69.0	S	0.60	0.00
IMP EMB				R	0.43	0.20
RANDOM ROCK	135.0	140.0	77.5	S	0.65	0.00
RANDOM ROCK				R	0.29	1.70

NOTES

1. R & S SHEAR STRENGTHS USED
2. SUBMERGED WEIGHTS USED BELOW GROUND SURFACE OF NEUTRAL BLOCK
3. $F.S. = \frac{TAN\,\phi}{TAN\,\phi_d}$, $F.S. = \frac{C}{C_d}$
4. α = 40°, 130' D/S FROM ℄ OF DAM. TYPICAL FAILURE SURFACE
5. COMPUTATIONS PRESENTED FOR TRIAL S.F. = 2.0
6. TAILWATER @ GROUND SURFACE EL. 965.0

PASSIVE WEDGE

$E_P = 2HC_d\sqrt{N_\phi} + \frac{\gamma}{2}H^2N_\phi$

$TAN\,\phi_d\ (S) = \frac{0.65}{2.0} = 0.326$ $\qquad$ $TAN\,\phi_d(R) = \frac{0.29}{2.0} = 0.145$

$\phi_d = 18°$ $\quad C_{d(S)} = 0$ $\qquad$ $\phi_d = 8.3°$ $\quad C_d(R) = \frac{1.7}{2.0} = 1.2$

$N_\phi = TAN^2(45° + \frac{\phi_d}{2})$

$N_\phi\ (S) = TAN^2(45° + 9°) = TAN^2(54°) = (1.38)^2 = 1.90$ $\qquad$ $N\phi(R) = TAN^2(45° + 4.1°) = TAN^2(49.1°) = (1.15)^2 = 1.32$

$E_P\ (S) = \frac{0.775}{2}(15)^2\,1.90 = 17^K$ $\qquad$ $E_P(R) = 2(15)(1.2)(1.15) + \frac{0.775}{2}(15)^2(1.32) = 55^K$

ACTIVE WEDGE

$W_A = 966^K$

WEIGHTED $TAN\,\phi_{(R\ TEST)}$

ROCK $\frac{6061}{7468}(0.29) = 0.235$

IMP $\frac{1401}{7468}(0.43) = 0.081$

WT $TAN\,\phi = 0.316$

$TAN\,\phi_d = \frac{0.316}{2.0} = 0.158$

$\phi_{d(R)} = 9.7°$

$C_A = 144(\frac{1.7}{2.0}) + 31(\frac{0.2}{2.0}) = 104^K$

WEIGHTED $TAN\,\phi_{(S\ TEST)}$

$\frac{6061}{7468}(0.65) = 0.528$

$\frac{1401}{7468}(0.60) = 0.113$

WT $TAN\,\phi = 0.644$

$TAN\,\phi_d = \frac{0.644}{2.0} = 0.322$

$\phi_{d(S)} = 17.9°$

NEUTRAL BLOCK

$W_{NB} = 172 \times 5 \times 69(0.135) + 16 \times 172(0.0776) = 1007^K$

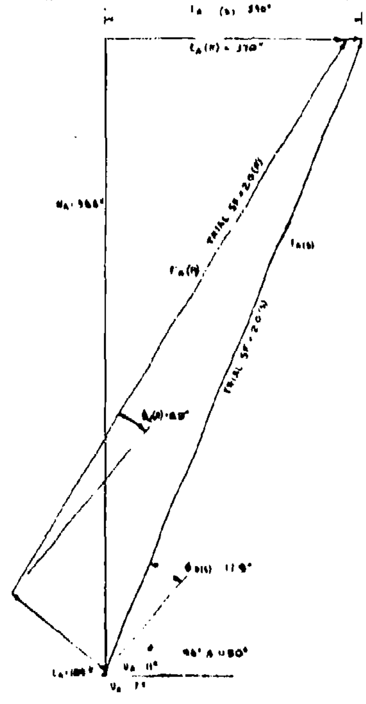
$TAN\,\phi_d\ (S) = \frac{0.65}{2.0} = 0.326$

$\phi_d(S) = 18°$

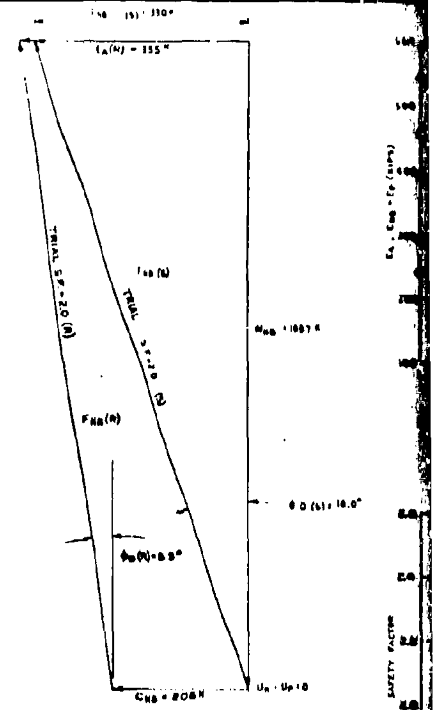
$TAN\,\phi_d(R) = \frac{0.29}{2.0} = 0.145$

$\phi_d(R) = 8.3°$

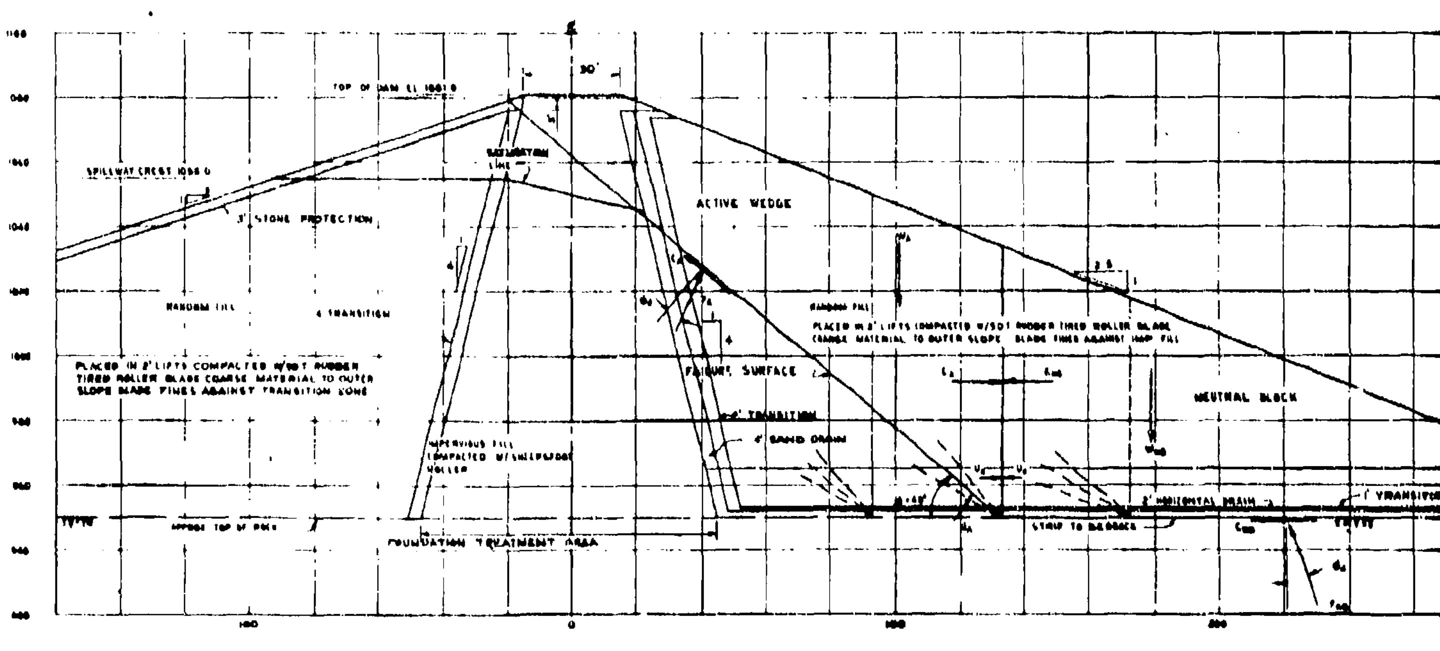
$C_{NB} = 172(\frac{1.7}{2.0}) = 208^K$

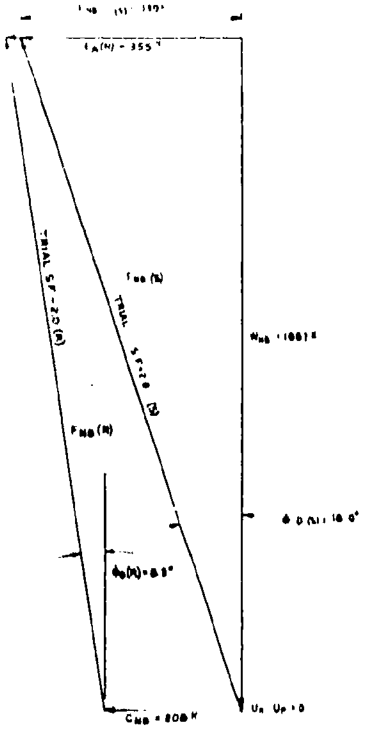


VECTOR DIAGRAM
ACTIVE WEDGE
SCALE 1" = 100K

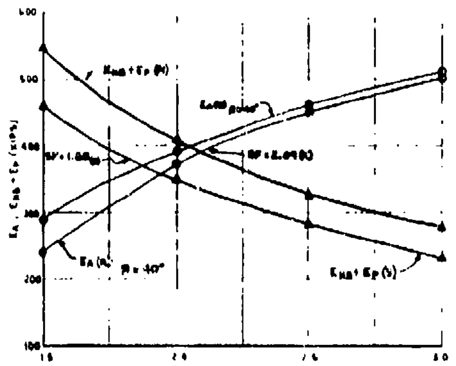


VECTOR DIAGRAM
NEUTRAL BLOCK
SCALE 1" = 100K

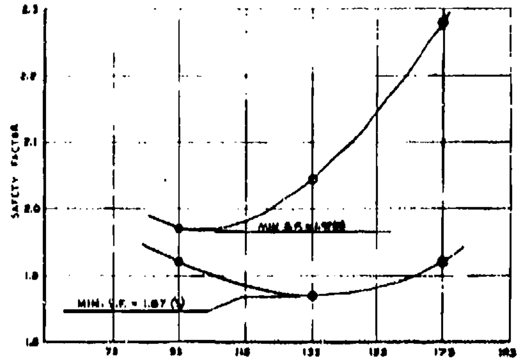




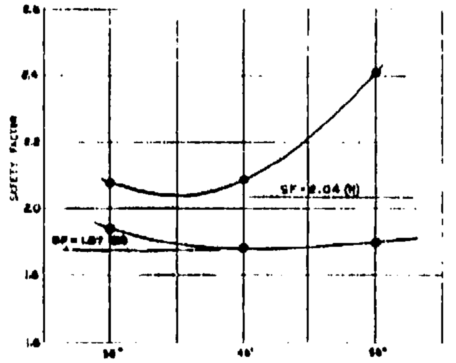
VECTOR DIAGRAM
NEUTRAL BLOCK
SCALE 1" = 100 K



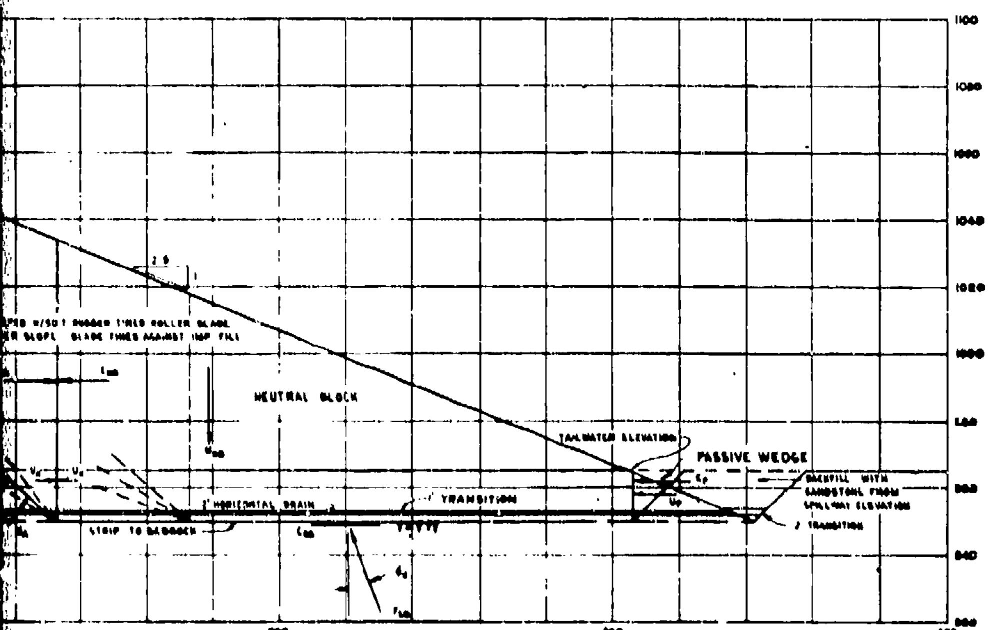
TRIAL FACTOR OF SAFETY



DISTANCE D/S FROM ℄ DAM



β ANGLE



U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

KENTUCKY RIVER BASIN, KY.
CARR FORK RESERVOIR
DOWNSTREAM DAM SECTION
STABILITY ANALYSIS
STEADY SEEPAGE

PLATE 2

ADOPTED DESIGN VALUES

MATERIAL	WT #/FT³			"R" STRENGTH		
	MOIST	SAT	SUB	φ	TAN φ	C T/FT²
IMP EMB	125.0	131.0	69.0	23.3°	0.43	0.80
RANDOM ROCK	136.0	140.0	77.6	[illegible]	[illegible]	1.20

NOTES
1. "R" SHEAR STRENGTH USED
2. SUBMERGED WEIGHTS USED BELOW POOL ELEVATION.
3. $F.S. = \frac{TAN\ \phi}{TAN\ \phi_d}$; $F.S. = \frac{C}{C_d}$
4. COMPUTATIONS PRESENTED FOR PLANE [illegible] U/S FROM ℄ DAM, $\alpha = 40°$, TRIAL S.F. = 2.0 & POOL ELEVATION 964.0

ACTIVE WEDGE

W_A = [illegible] = 1036 K

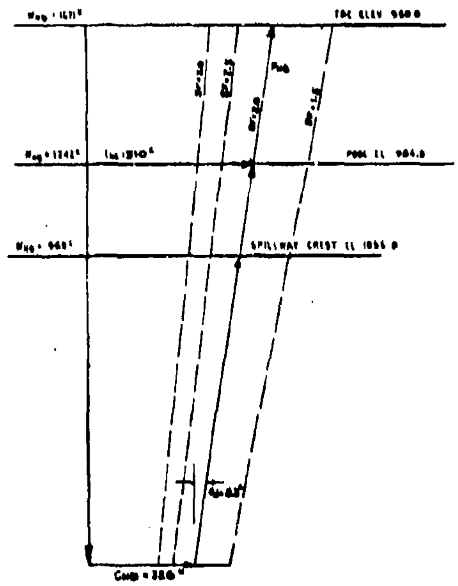
WEIGHTED VALUES
EMB [illegible]
ROCK [illegible]
WEIGHTED TAN φ [illegible]
TAN ϕ_d = [illegible]
ϕ_d = [illegible]

C_A = [illegible] = 104 K

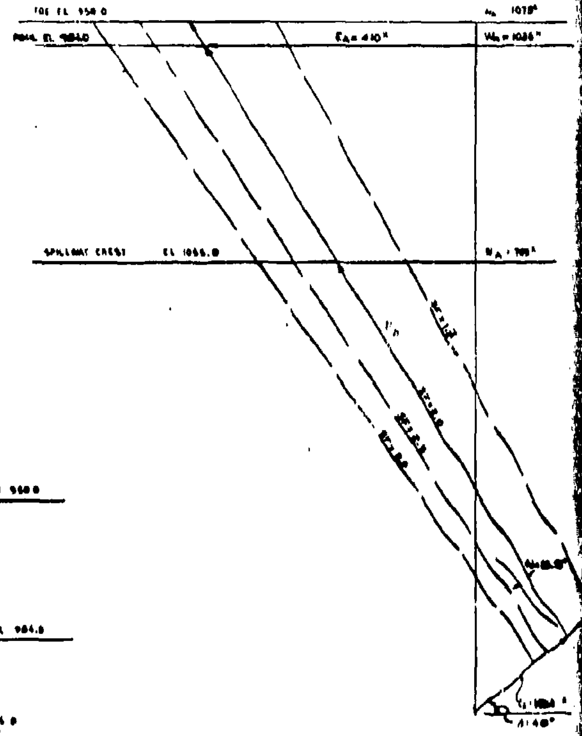
NEUTRAL BLOCK

W_{NB} = [illegible] = 1242 K

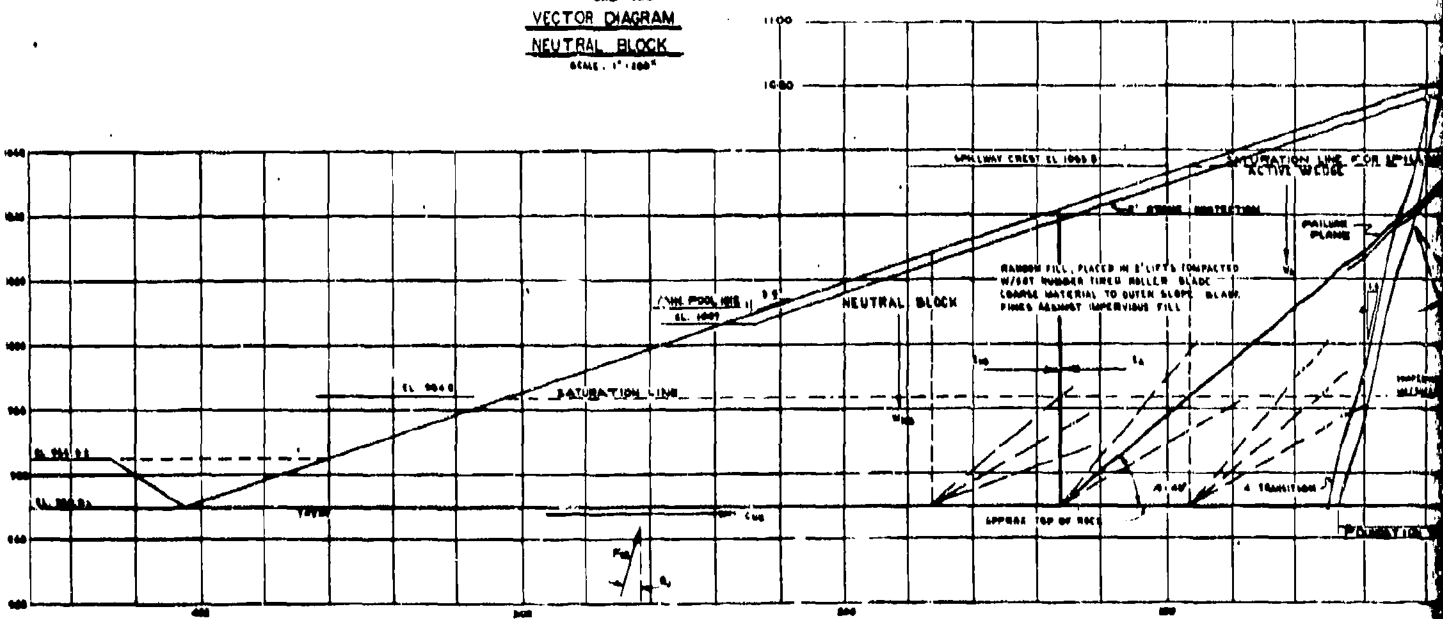
TAN ϕ_d = [illegible] C_{NB} = [illegible] = 386 K
ϕ_d = [illegible]



VECTOR DIAGRAM
NEUTRAL BLOCK
SCALE: 1" = 100 K



VECTOR DIAGRAM
ACTIVE WEDGE
SCALE 1" = 100 K



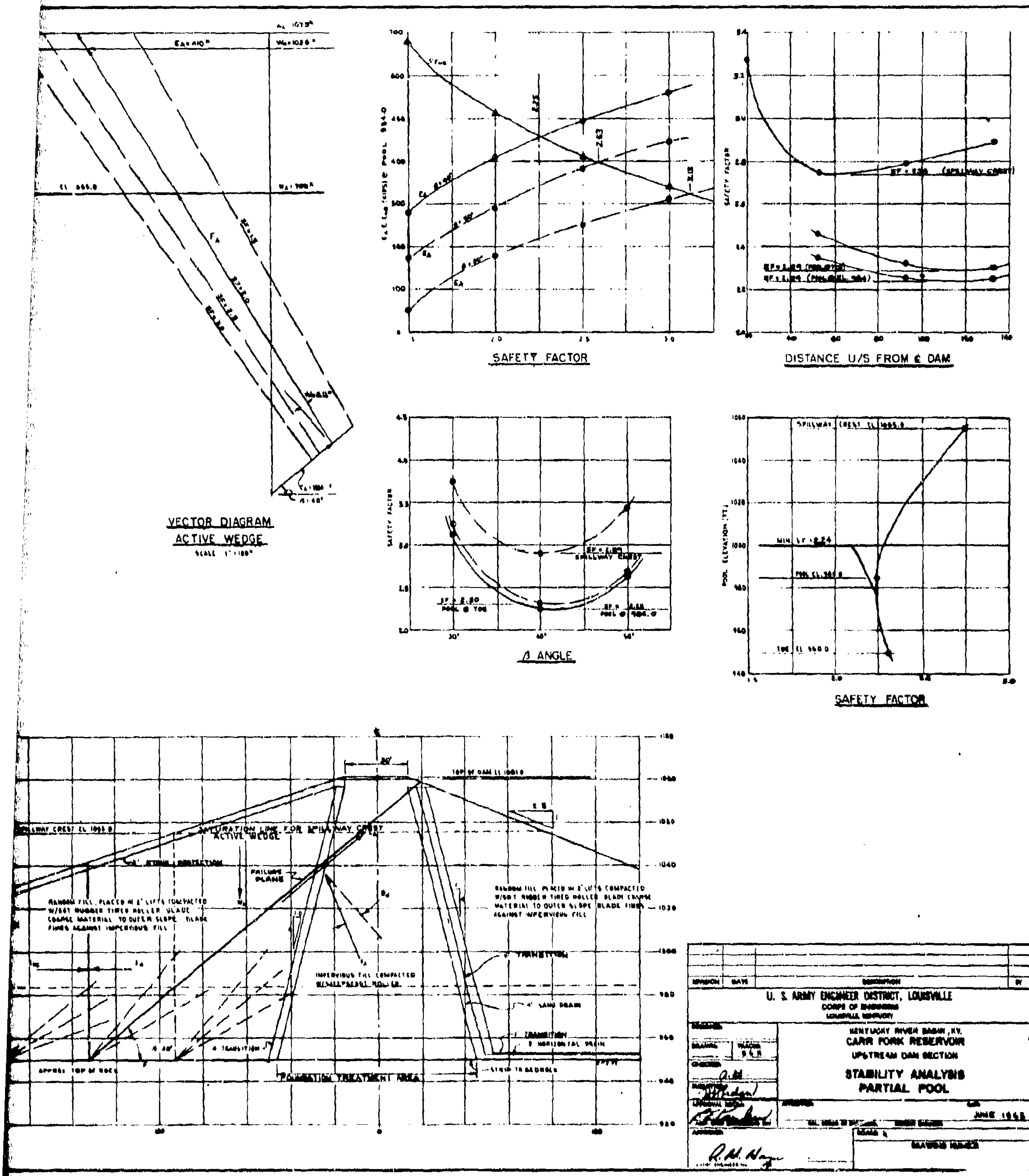
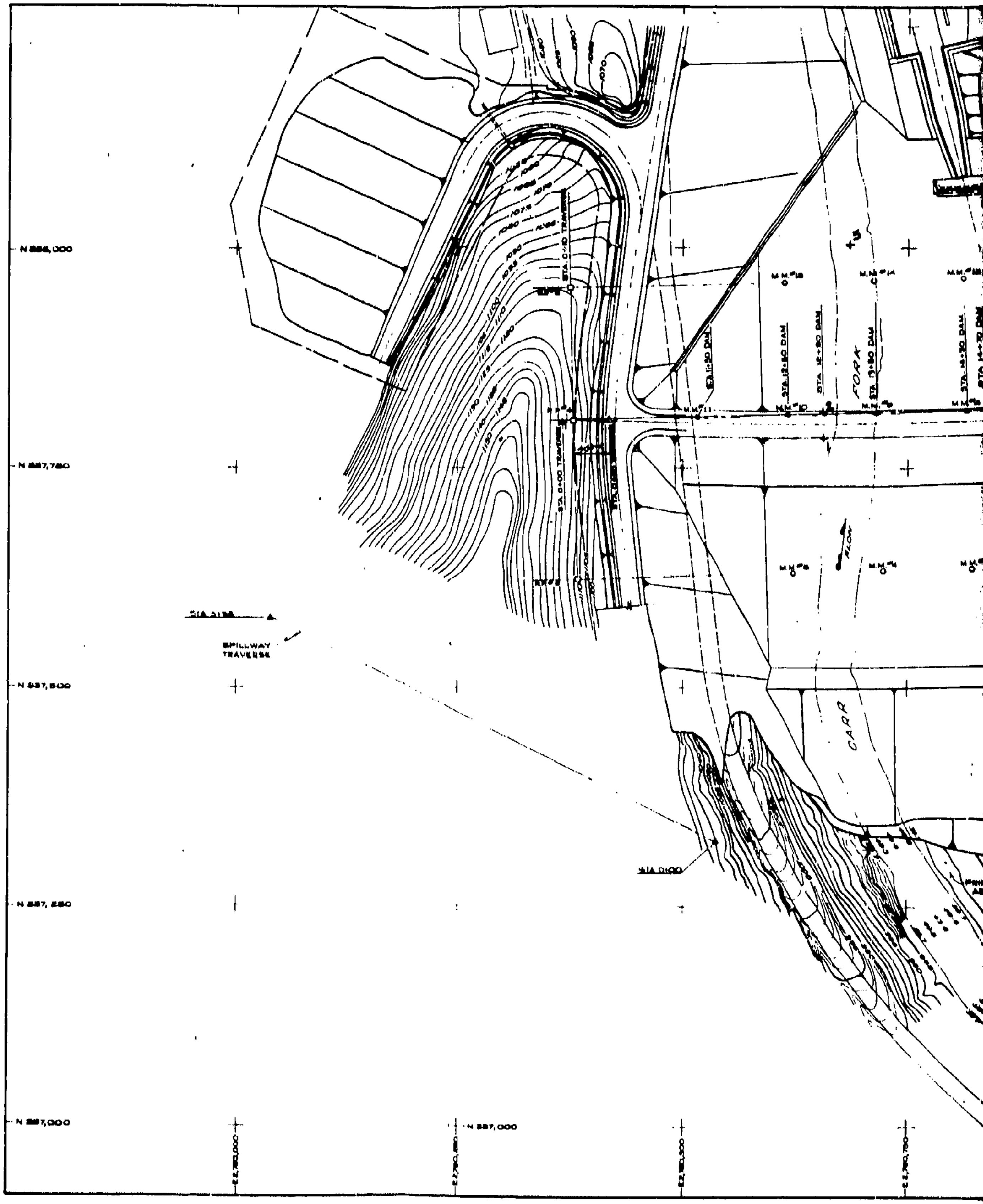

SAFETY FACTOR
DISTANCE U/S FROM ℄ DAM
VECTOR DIAGRAM
ACTIVE WEDGE
β ANGLE
SAFETY FACTOR
SATURATION LINE FOR SPILLWAY CREST
ACTIVE WEDGE
FAILURE PLANE
TRANSITION
FOUNDATION TREATMENT AREA
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY
KENTUCKY RIVER BASIN, KY.
CARR FORK RESERVOIR
UPSTREAM DAM SECTION
STABILITY ANALYSIS
PARTIAL POOL

PLATE 27

CORPS OF ENGINEERS



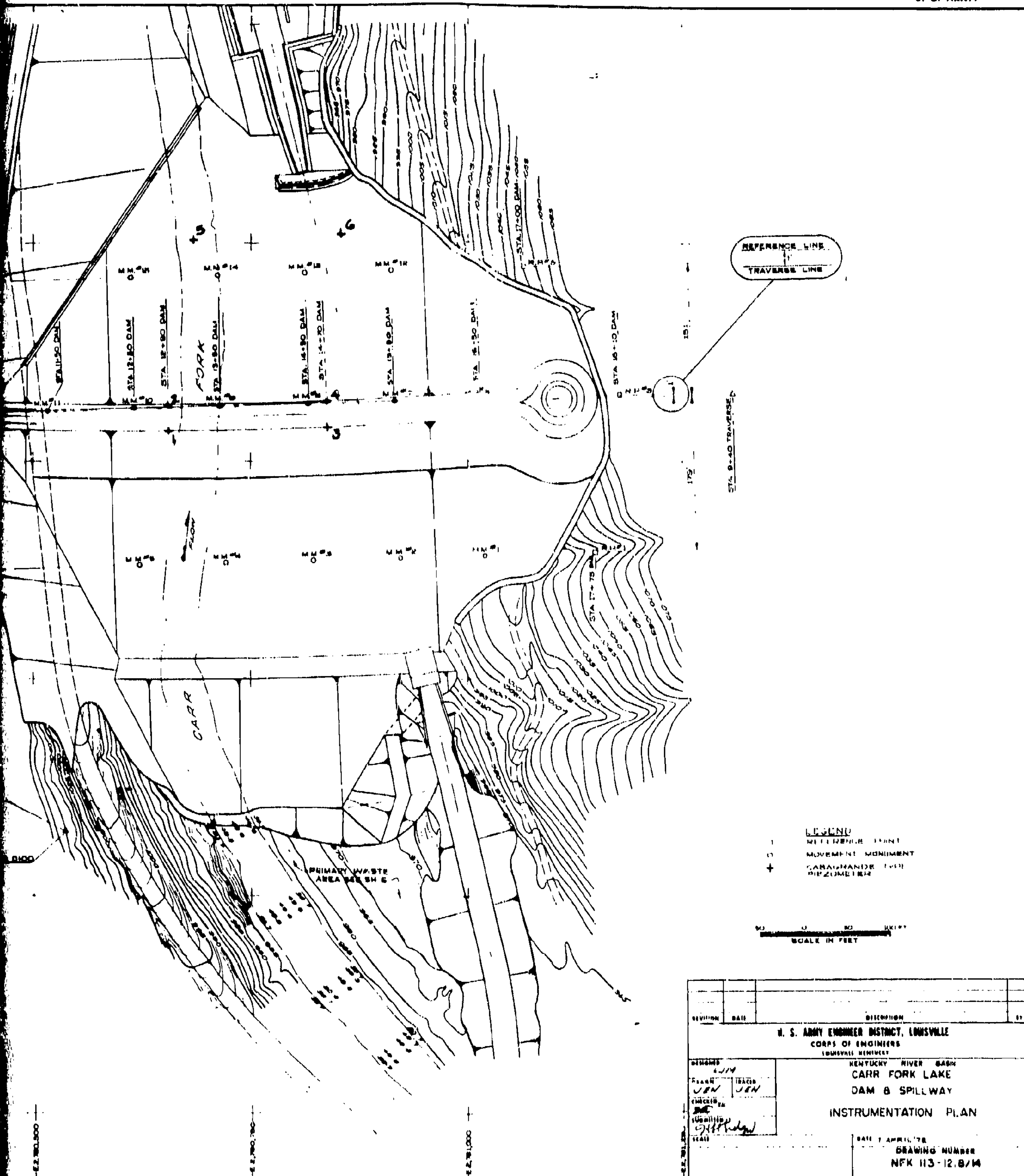
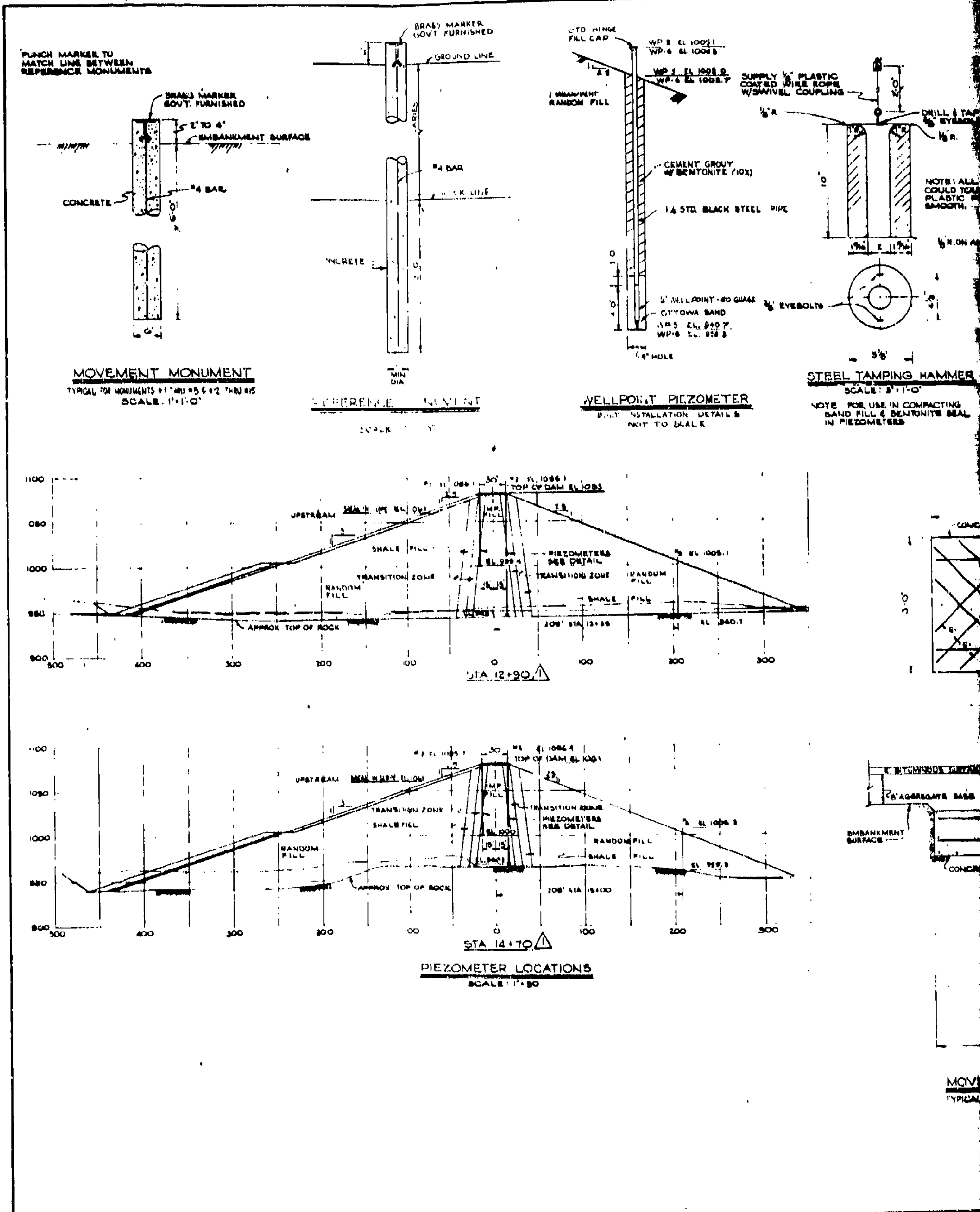

REFERENCE LINE
TRAVERSE LINE
CARR
FORK
FLOW
PRIMARY WASTE AREA SEE SH 6
LEGEND
REFERENCE POINT
MOVEMENT MONUMENT
CASAGRANDE TYPE PIEZOMETER
SCALE IN FEET
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
KENTUCKY RIVER BASIN
CARR FORK LAKE
DAM & SPILLWAY
INSTRUMENTATION PLAN
DRAWING NUMBER
NFK 113-12.8/14

PLATE 28

CORPS OF ENGINEERS



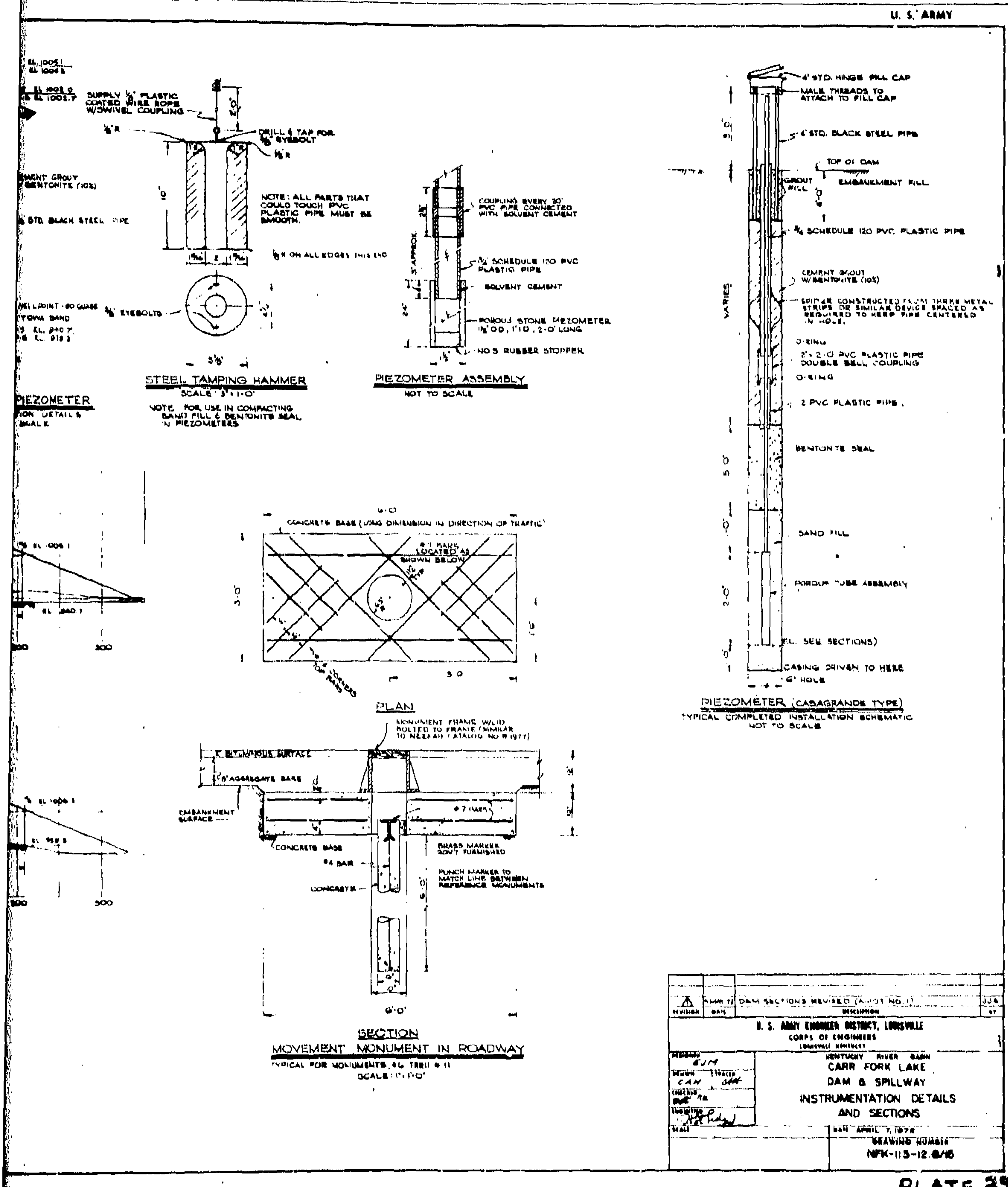
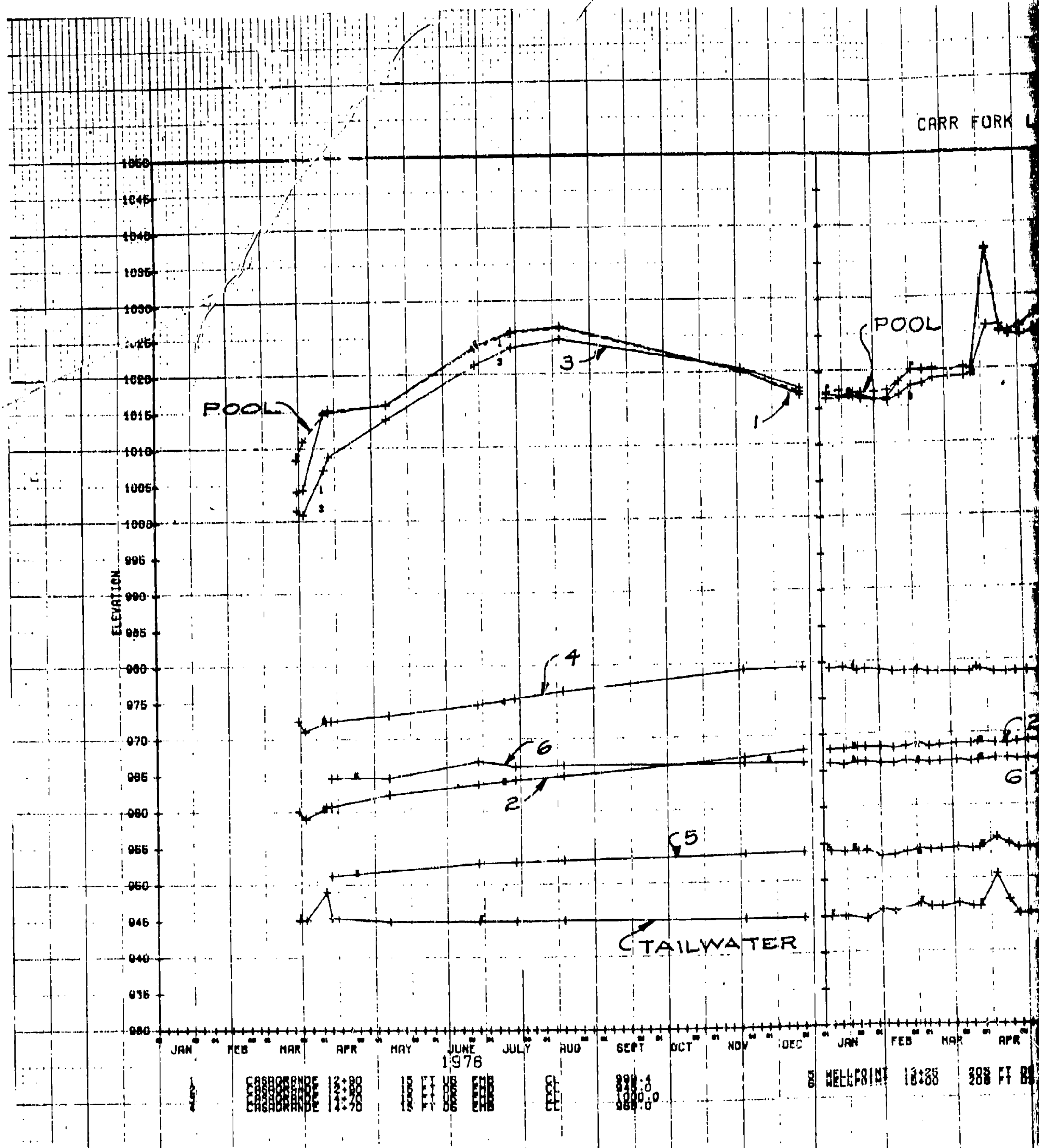

U. S. ARMY
SUPPLY 1/8" PLASTIC COATED WIRE ROPE W/SWIVEL COUPLING
DRILL & TAP FOR 5/8" EYEBOLT
NOTE: ALL PARTS THAT COULD TOUCH PVC PLASTIC PIPE MUST BE SMOOTH.
5/8" EYEBOLTS
STEEL TAMPING HAMMER
SCALE: 3" = 1'-0"
NOTE: FOR USE IN COMPACTING SAND FILL & BENTONITE SEAL IN PIEZOMETERS
COUPLING EVERY 20' PVC PIPE CONNECTED WITH SOLVENT CEMENT
3/4" SCHEDULE 120 PVC PLASTIC PIPE
SOLVENT CEMENT
POROUS STONE PIEZOMETER
NO. 5 RUBBER STOPPER
PIEZOMETER ASSEMBLY
NOT TO SCALE
PIEZOMETER
4" STD. HINGE FILL CAP
MALE THREADS TO ATTACH TO FILL CAP
4" STD. BLACK STEEL PIPE
TOP OF DAM
EMBANKMENT FILL
GROUT FILL
3/4" SCHEDULE 120 PVC PLASTIC PIPE
CEMENT GROUT W/BENTONITE (10%)
O-RING
2" x 2'-0 PVC PLASTIC PIPE DOUBLE BELL COUPLING
O-RING
2 PVC PLASTIC PIPE
BENTONITE SEAL
SAND FILL
POROUS TUBE ASSEMBLY
CASING DRIVEN TO HERE
6" HOLE
VARIES
PIEZOMETER (CASAGRANDE TYPE)
TYPICAL COMPLETED INSTALLATION SCHEMATIC
NOT TO SCALE
CONCRETE BASE (LONG DIMENSION IN DIRECTION OF TRAFFIC)
PLAN
BITUMINOUS SURFACE
6" AGGREGATE BASE
EMBANKMENT SURFACE
CONCRETE BASE
#4 BAR
CONCRETE
#7 BARS
BRASS MARKER GOV'T FURNISHED
PUNCH MARKER TO MATCH LINE BETWEEN REFERENCE MONUMENTS
SECTION
MOVEMENT MONUMENT IN ROADWAY
TYPICAL FOR MONUMENTS
SCALE: 1" = 1'-0"
DAM SECTIONS REVISED
REVISION
DATE
DESCRIPTION
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY
KENTUCKY RIVER BASIN
CARR FORK LAKE
DAM & SPILLWAY
INSTRUMENTATION DETAILS AND SECTIONS
DATE APRIL 7, 1978
DRAWING NUMBER
NFK-113-12.8/16

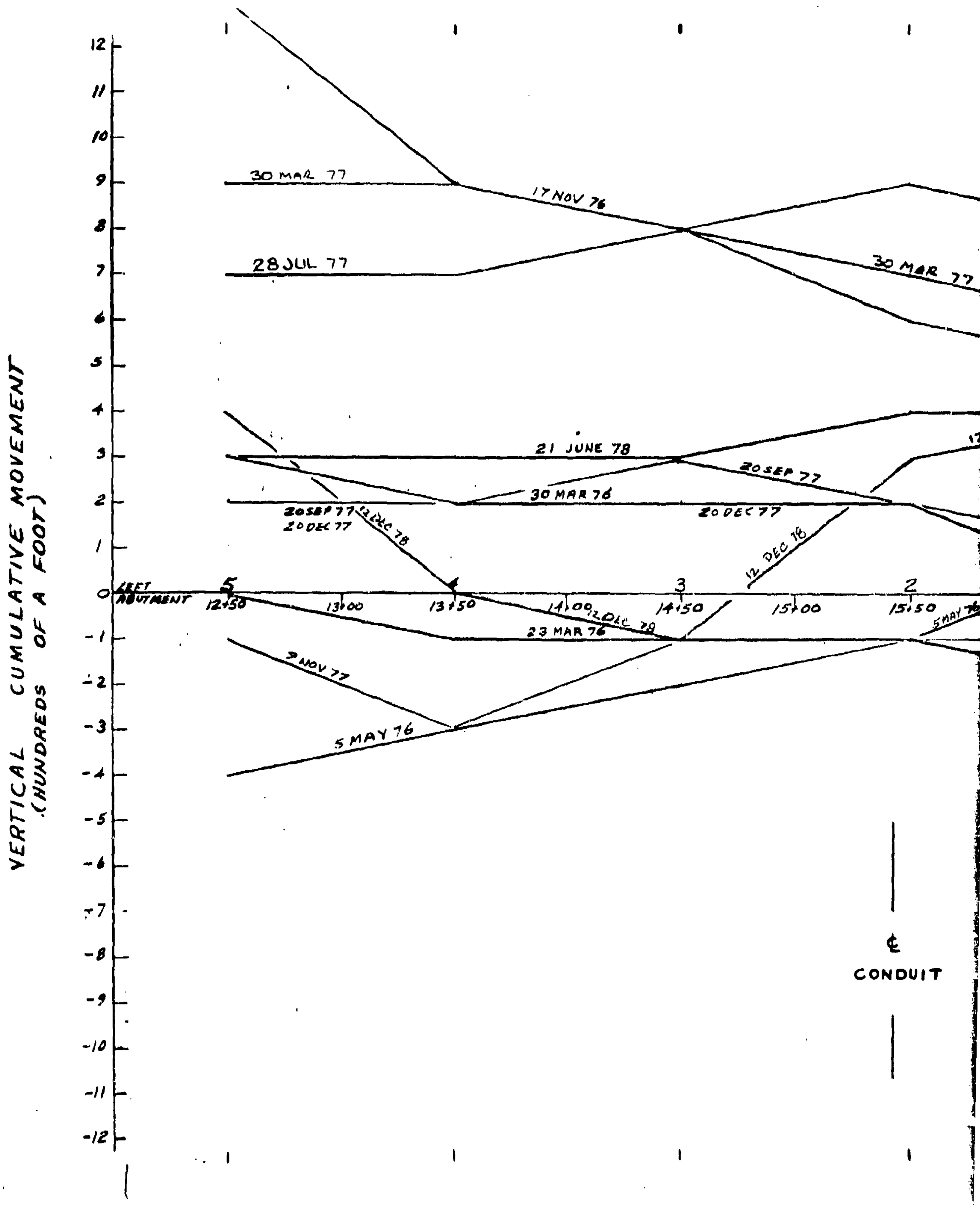
PLATE 29



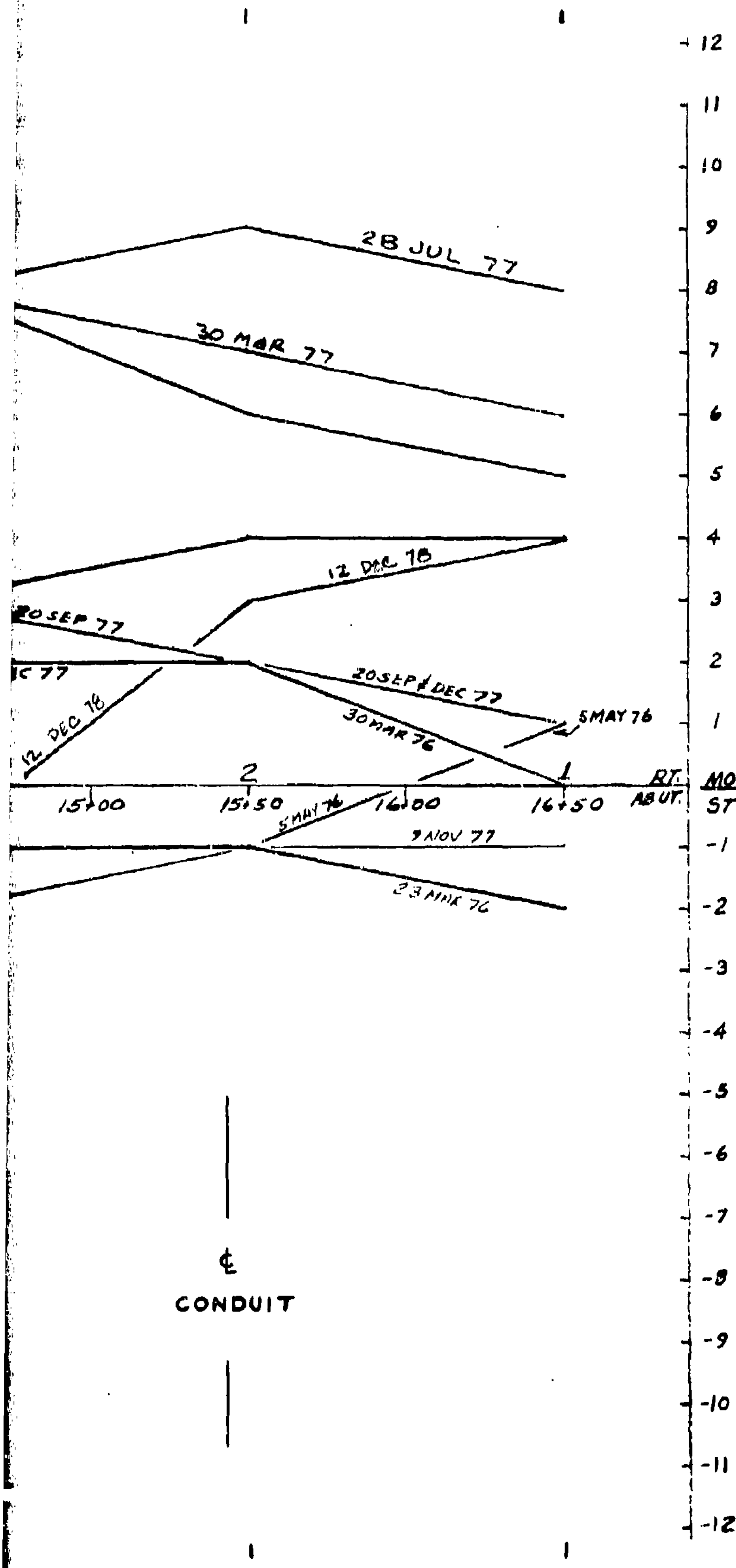
CARR FORK
ELEVATION
POOL
TAILWATER
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1976

POOL
3
1
4
2
6
5
TAILWATER
TAILWATER
ELEVATION
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1977
1978
ROCK 940.7
ROCK 959.3

PLATE 2



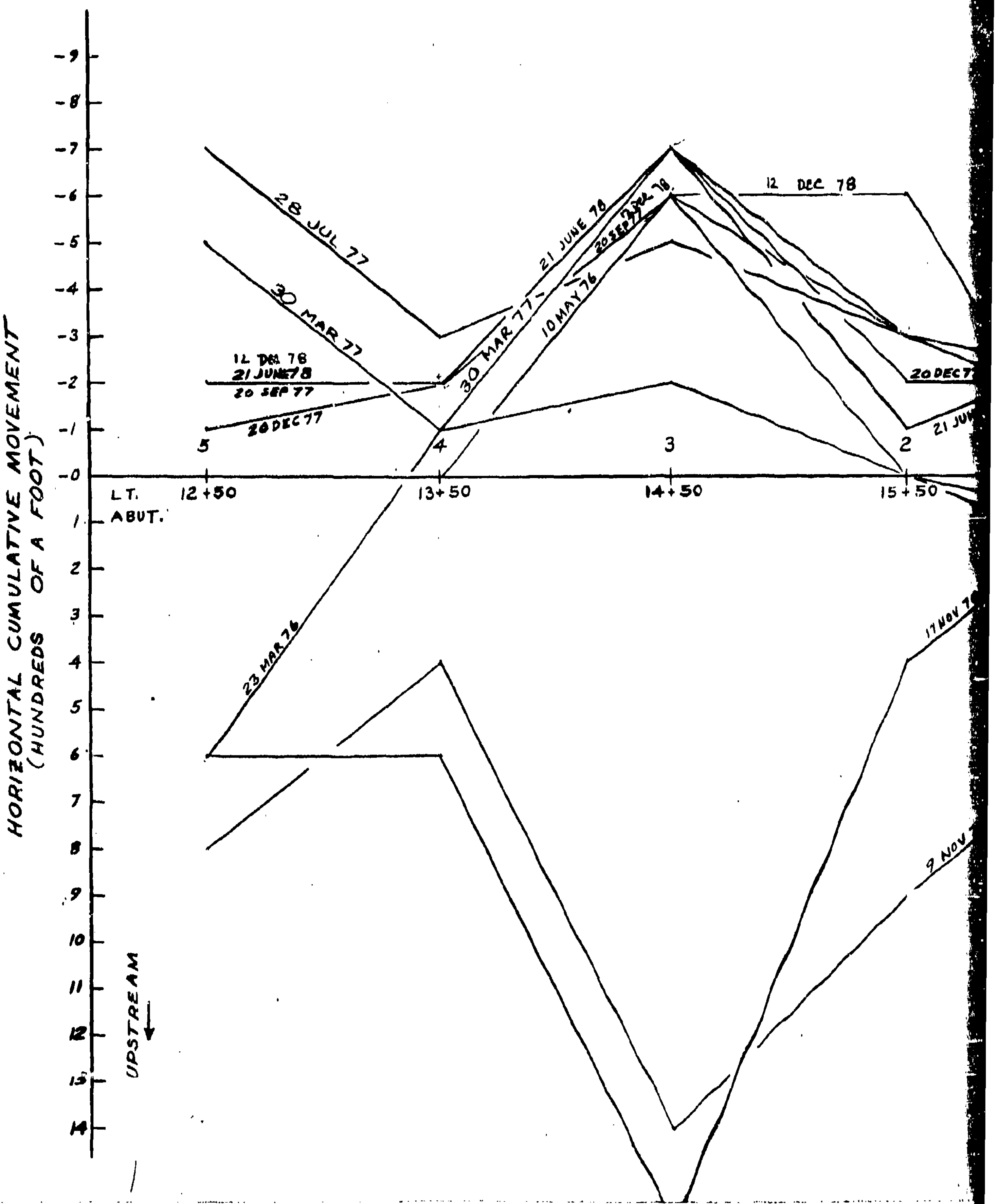
VERTICAL CUMULATIVE MOVEMENT
(HUNDREDS OF A FOOT)
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
LEFT ABUTMENT
5
4
3
2
12+50
13+00
13+50
14+00
14+50
15+00
15+50
30 MAR 77
17 NOV 76
28 JUL 77
30 MAR 77
21 JUNE 78
20 SEP 77
30 MAR 76
20 DEC 77
20 SEP 77
20 DEC 77
12 DEC 78
12 DEC 78
12 DEC 78
23 MAR 76
9 NOV 77
5 MAY 76
5 MAY 76
CONDUIT

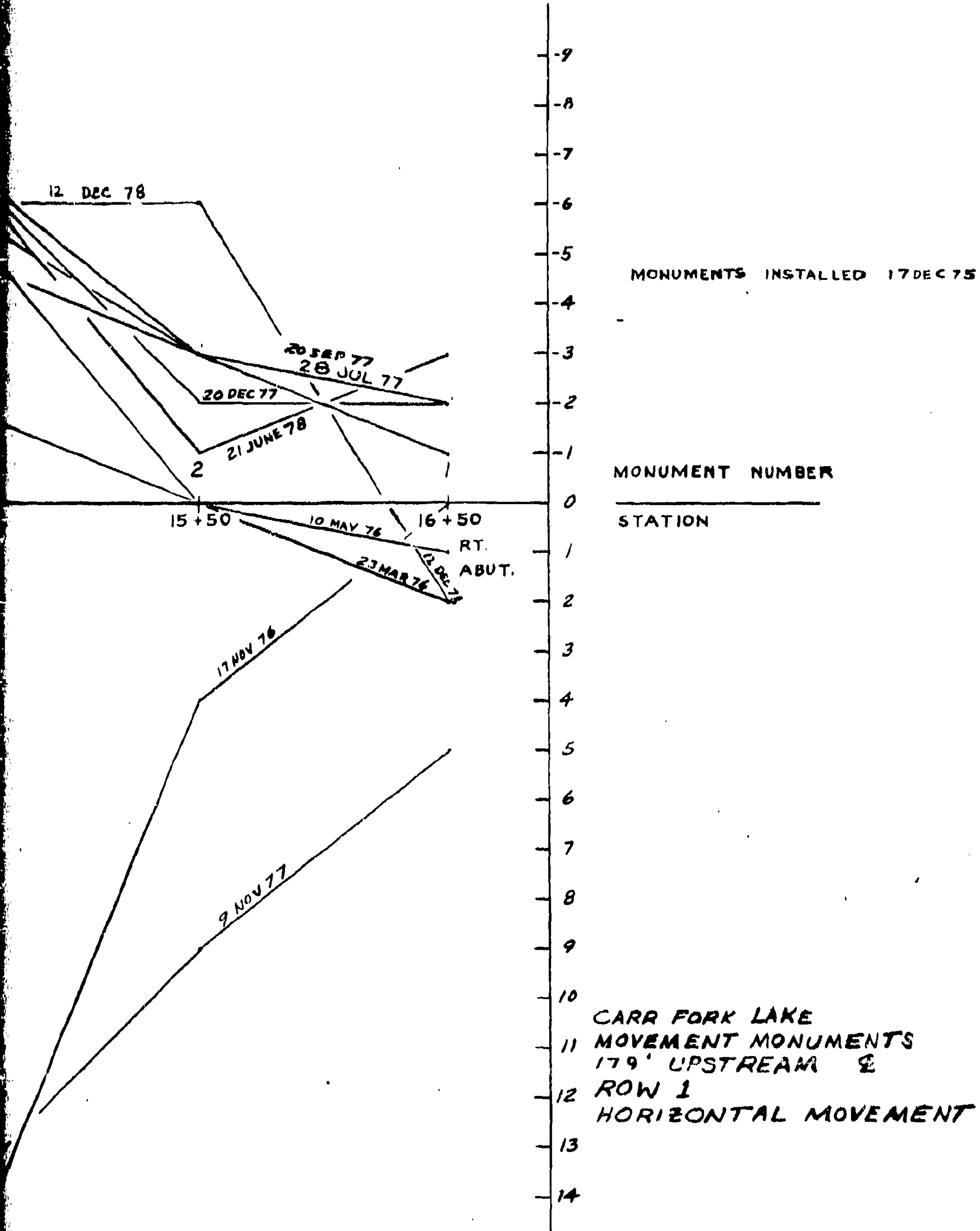


17 DEC 75

INITIAL READING	
MON. NO.	ELEV.
1	1028.60
2	1029.29
3	1030.72
4	1030.23
5	1028.96

CARR FORK LAKE
MOVEMENT MONUMENTS
179' UPSTREAM ℄
ROW 1
VERTICAL MOVEMENT

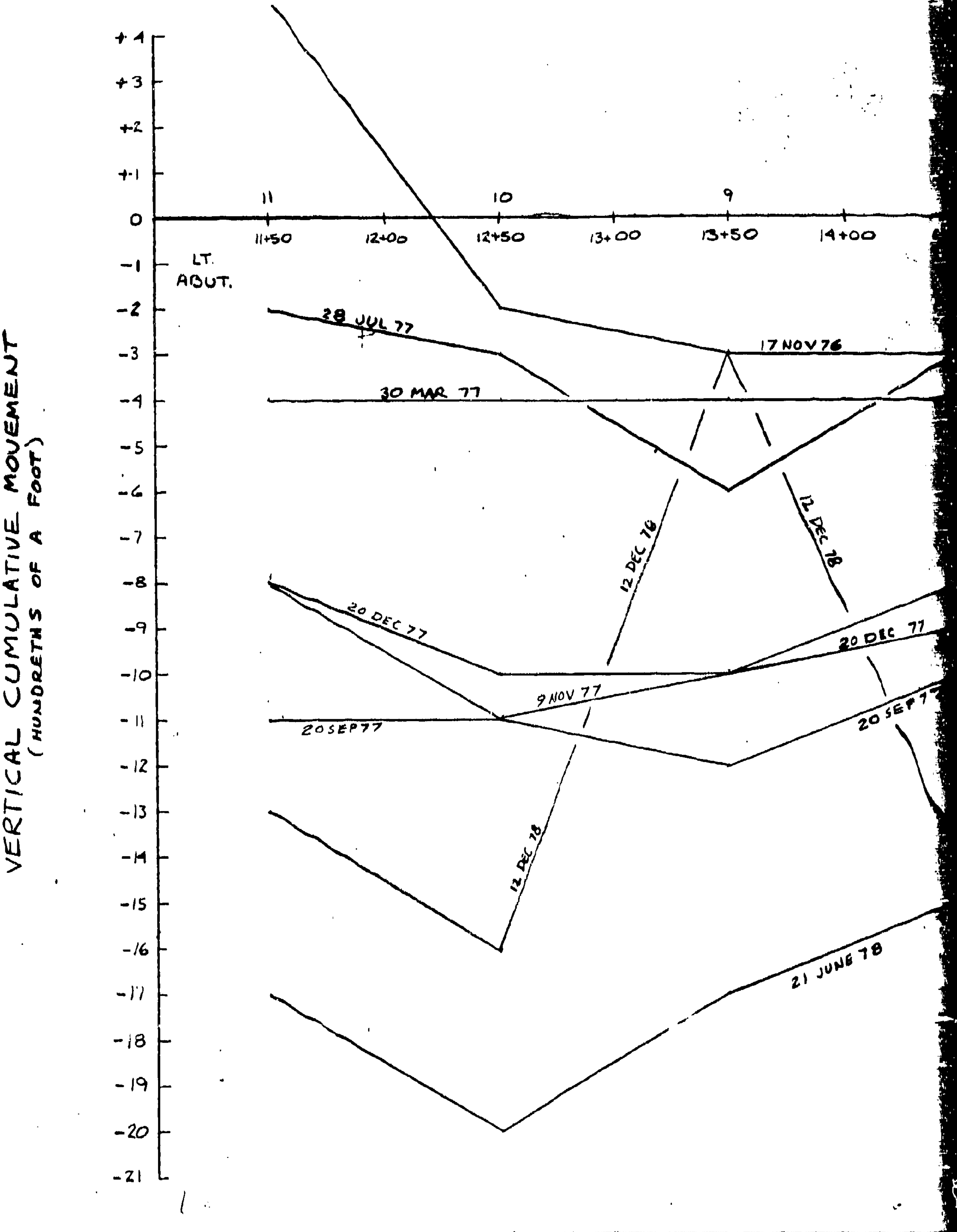

HORIZONTAL CUMULATIVE MOVEMENT
(HUNDREDS OF A FOOT)
-9
-8
-7
-6
-5
-4
-3
-2
-1
-0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
LT. ABUT.
12+50
13+50
14+50
15+50
5
4
3
2
28 JUL 77
30 MAR 77
12 DEC 78
21 JUNE 78
20 SEP 77
20 DEC 77
10 MAY 76
23 MAR 76
UPSTREAM
17 NOV 7
9 NOV

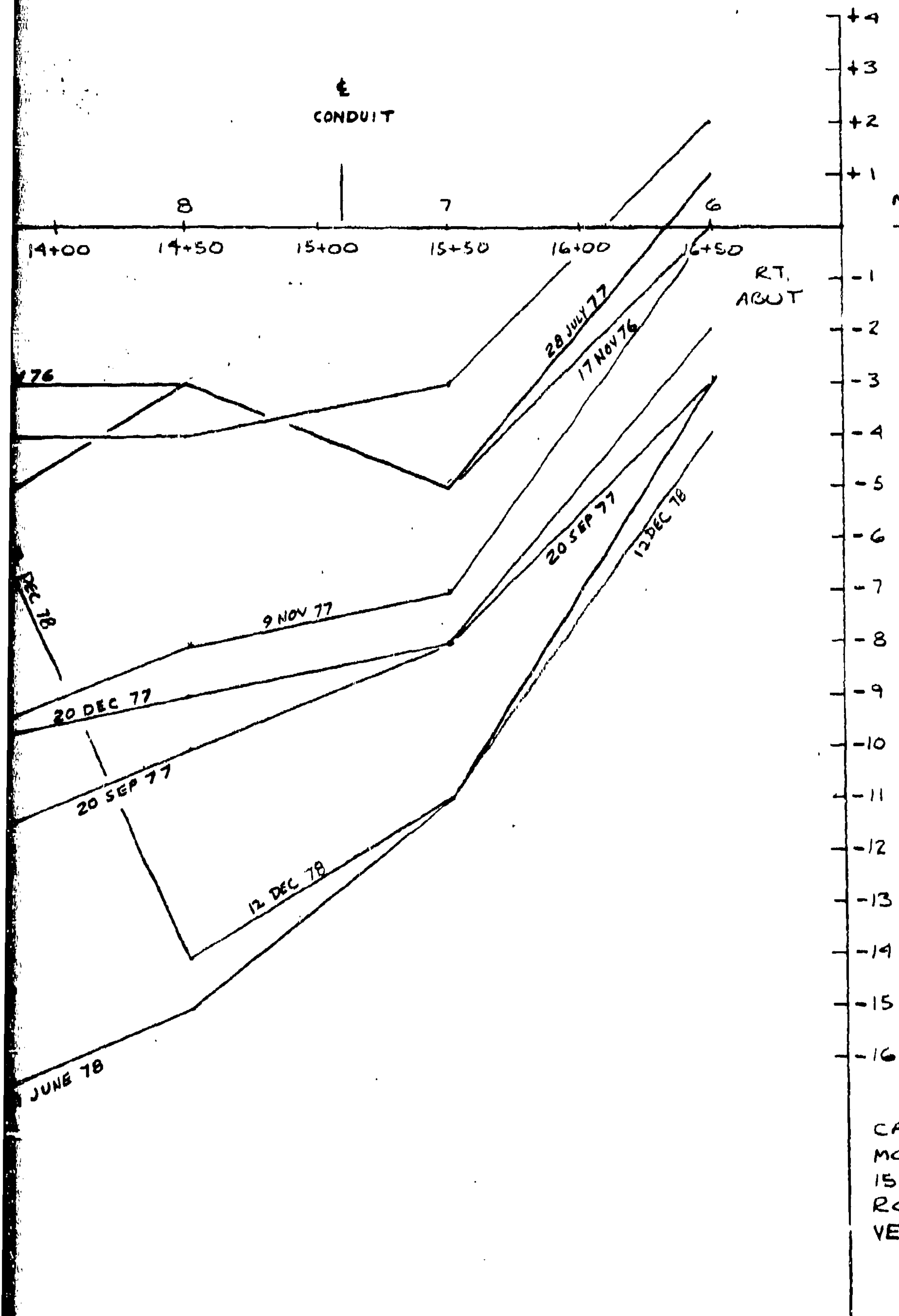


CARR FORK LAKE
MOVEMENT MONUMENTS
179' UPSTREAM ℄
ROW 1
HORIZONTAL MOVEMENT

2

PLATE 32


VERTICAL CUMULATIVE MOVEMENT
(HUNDREDTHS OF A FOOT)
+4
+3
+2
+1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
-16
-17
-18
-19
-20
-21
11
10
9
11+50
12+00
12+50
13+00
13+50
14+00
LT.
ABUT.
28 JUL 77
17 NOV 76
30 MAR 77
12 DEC 76
12 DEC 78
20 DEC 77
20 DEC 77
9 NOV 77
20 SEP 77
20 SEP 77
12 DEC 78
21 JUNE 78



MONUMENT NUMBER

STATION

21 JAN 76

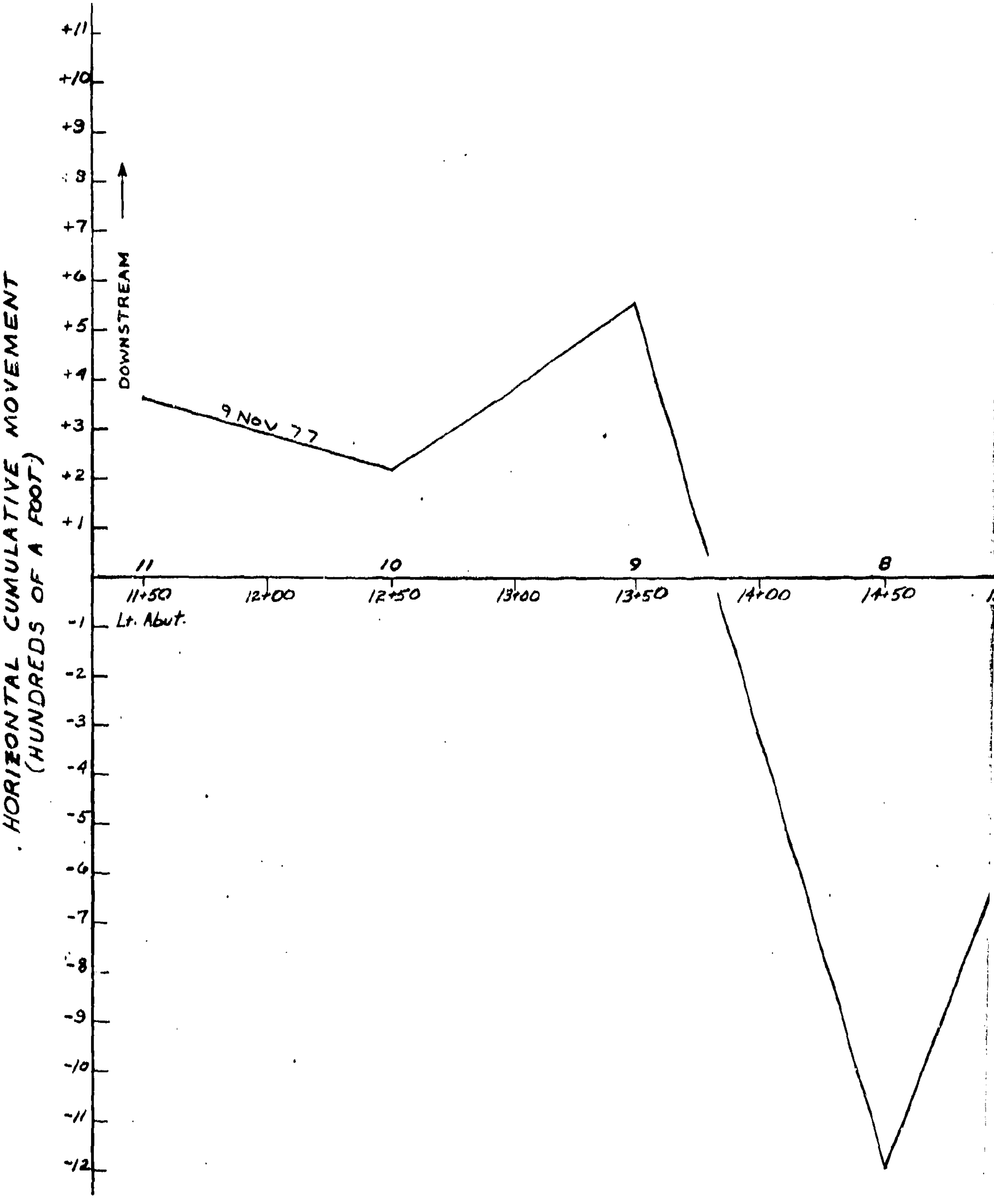
INITIAL READING	
MON. NO.	ELEV.
6	1081.79 *
7	1081.19
8	1081.32
9	1081.14
10	1081.31
11	1081.27

* 17 NOV 76 - MON. NO. 6 REPLACED

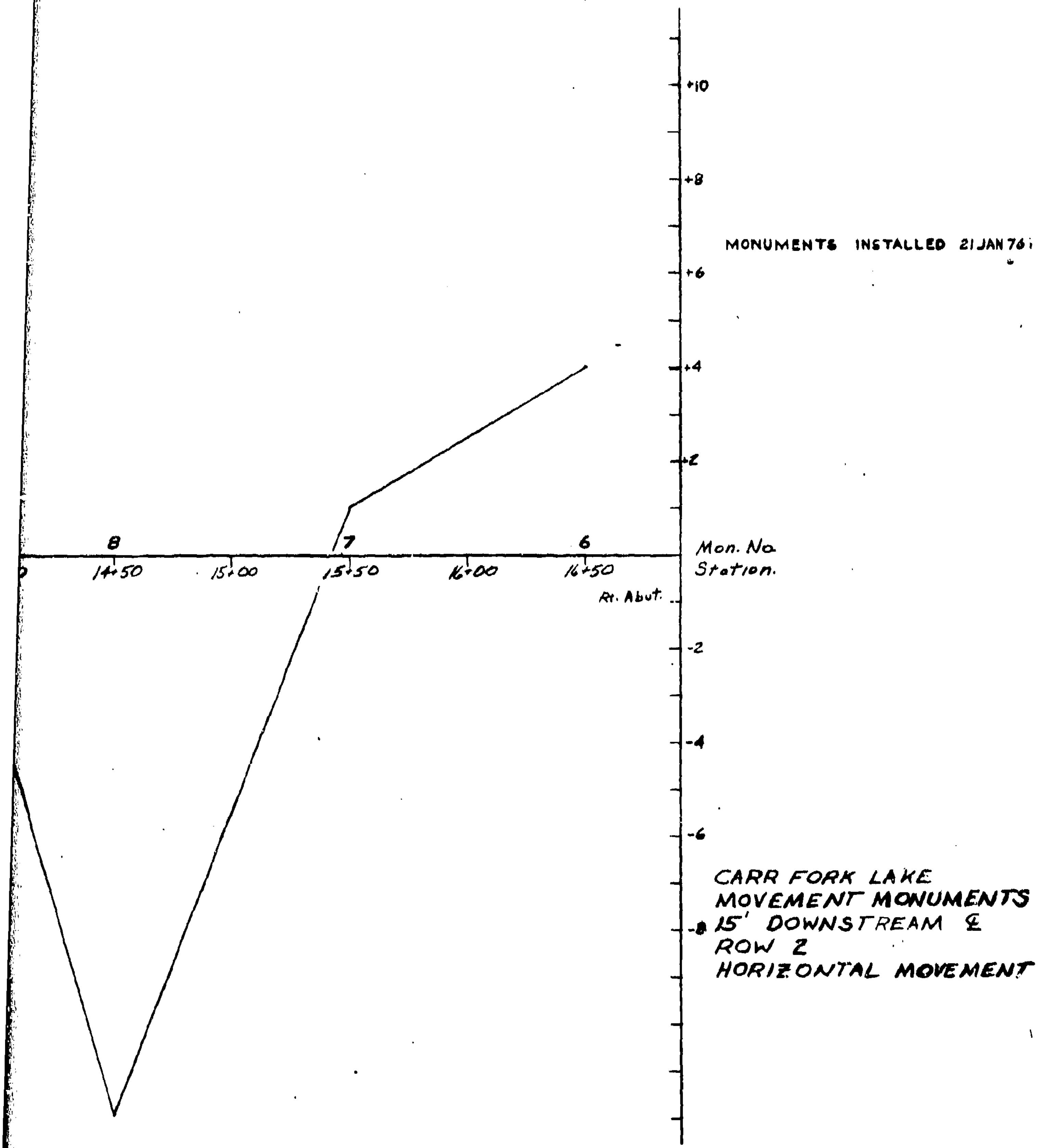
CARR FORK LAKE
MOVEMENT MONUMENTS
15' DOWNSTREAM OF ℄
ROW 2
VERTICAL MOVEMENT

PLATE 93

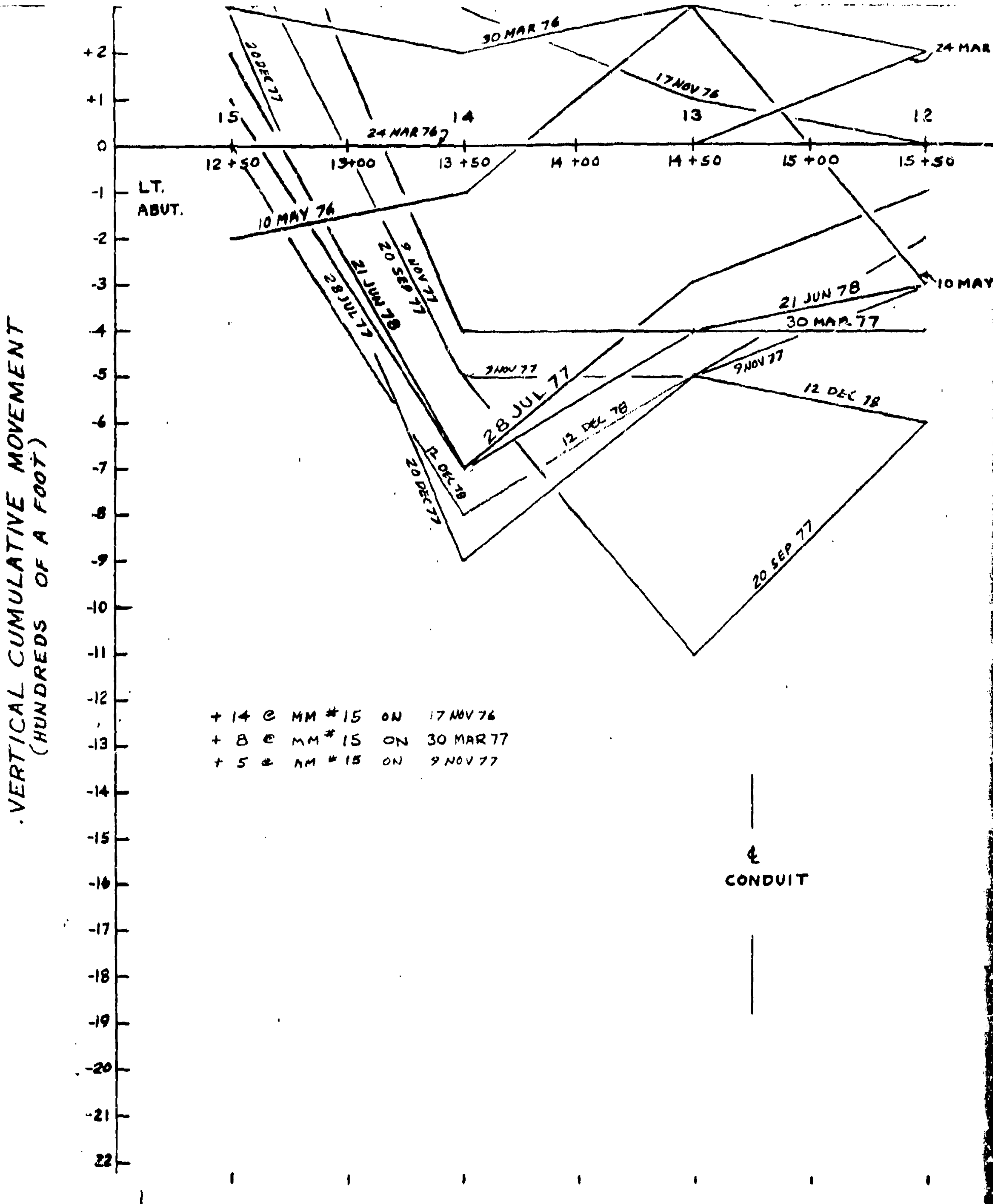
2



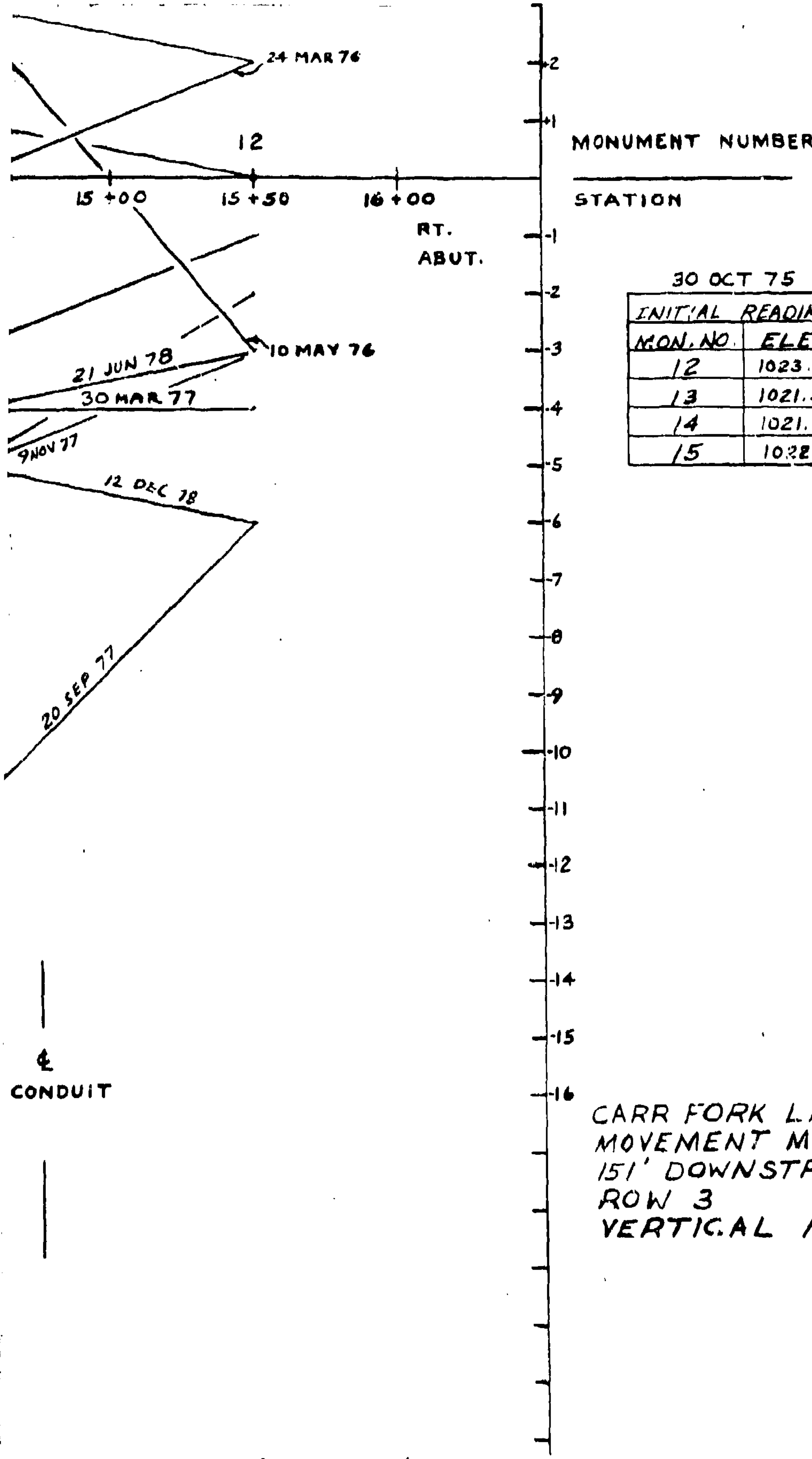
HORIZONTAL CUMULATIVE MOVEMENT
(HUNDREDS OF A FOOT)
DOWNSTREAM
+11
+10
+9
+8
+7
+6
+5
+4
+3
+2
+1
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
9 NOV 77
11
10
9
8
11+50
12+00
12+50
13+00
13+50
14+00
14+50
Lt. Abut.



CARR FORK LAKE
MOVEMENT MONUMENTS
15' DOWNSTREAM ℄
ROW 2
HORIZONTAL MOVEMENT



VERTICAL CUMULATIVE MOVEMENT
(HUNDREDS OF A FOOT)
+2
+1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
-16
-17
-18
-19
-20
-21
22
15
14
13
12
12 +50
13+00
13 +50
14 +00
14 +50
15 +00
15 +50
LT. ABUT.
30 MAR 76
24 MAR 7
20 DEC 77
17 NOV 76
24 MAR 76
10 MAY 76
10 MAY
21 JUN 78
30 MAR 77
28 JUL 77
21 JUN 78
20 SEP 77
9 NOV 77
9 NOV 77
9 NOV 77
28 JUL 77
12 DEC 78
12 DEC 78
12 DEC 78
20 DEC 77
20 SEP 77
+ 14 @ MM # 15 ON 17 NOV 76
+ 8 @ MM # 15 ON 30 MAR 77
+ 5 @ MM # 15 ON 9 NOV 77
℄ CONDUIT

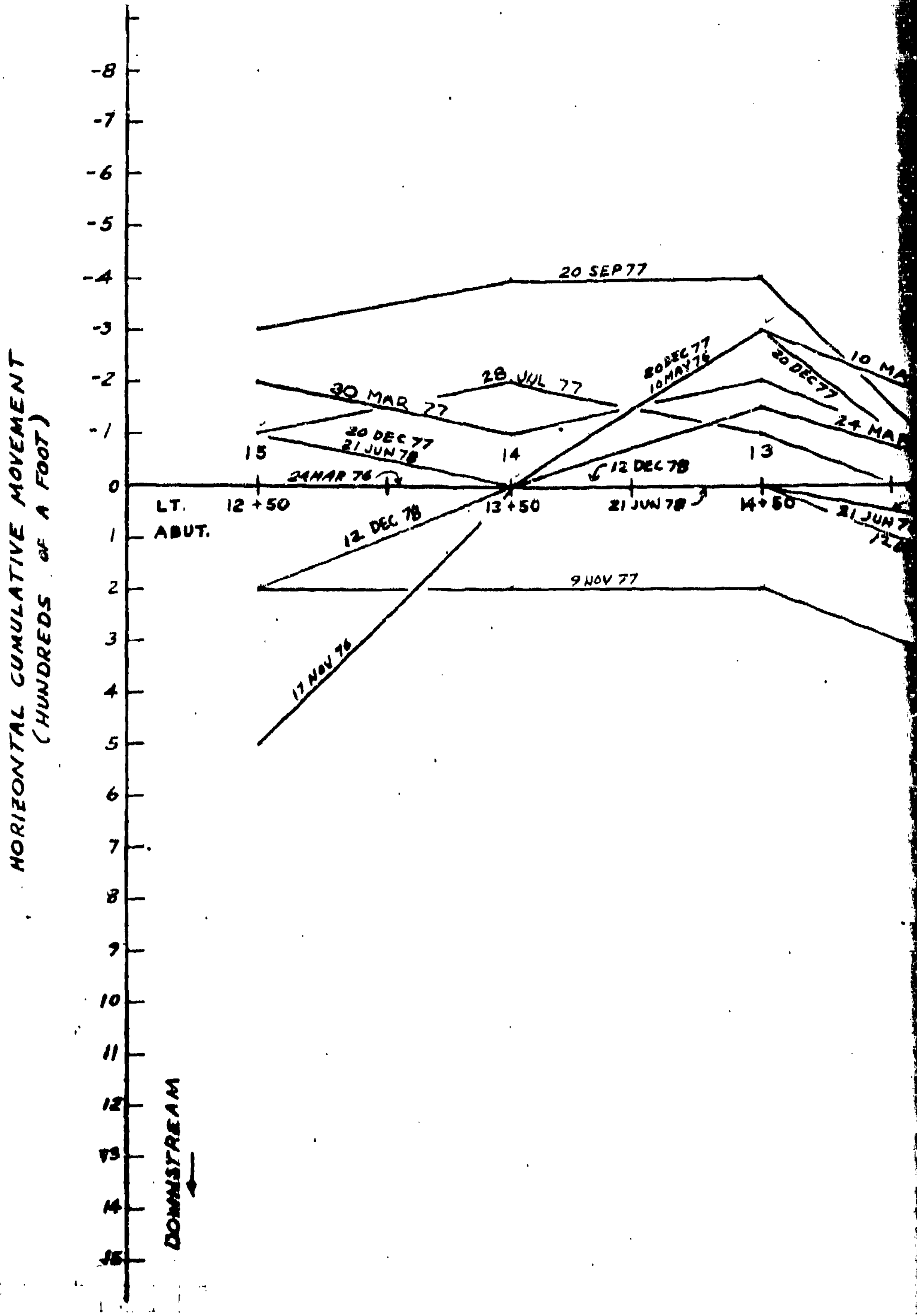


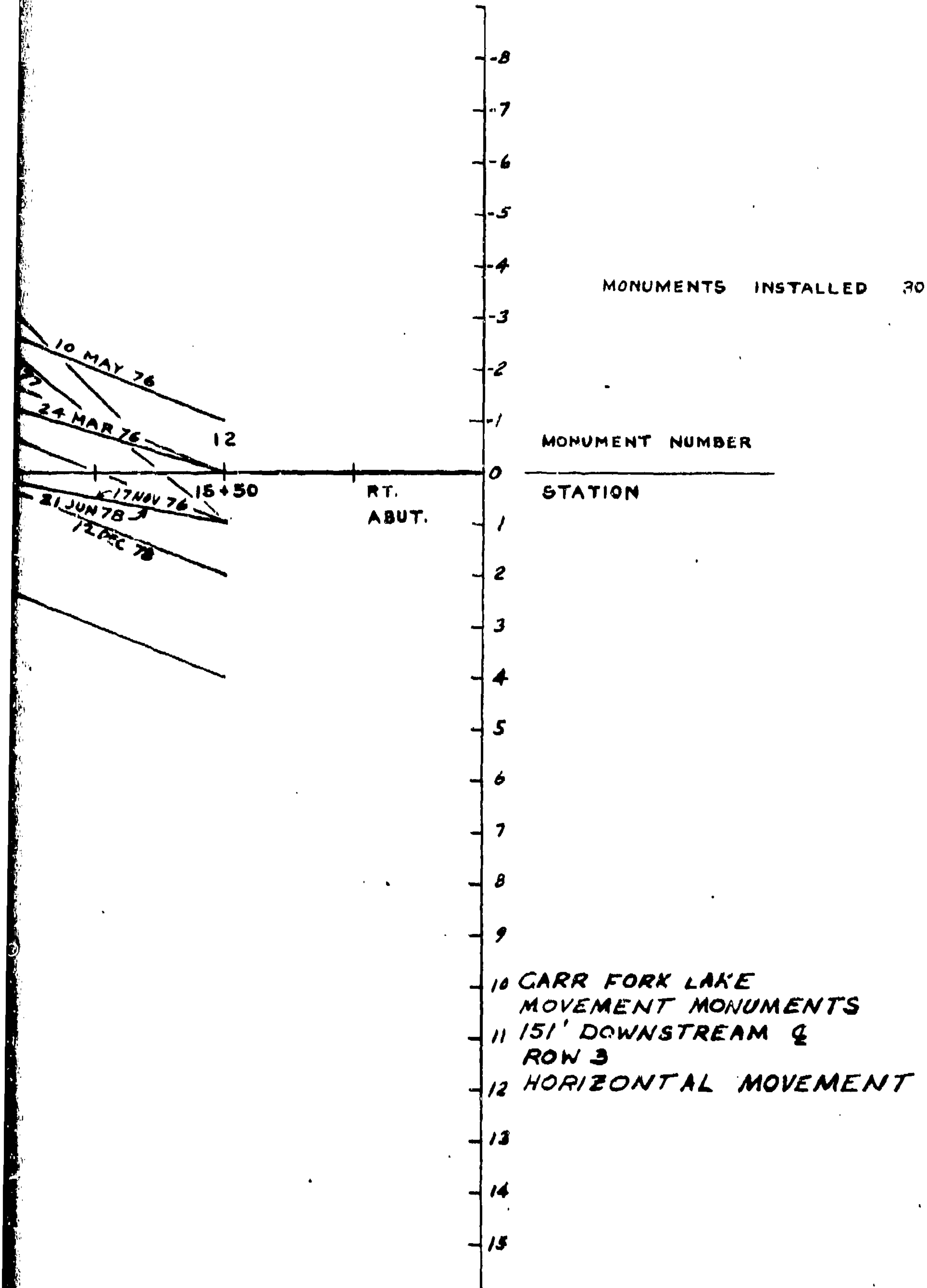
30 OCT 75

INITIAL READING	
MON. NO.	ELEV.
12	1023.13
13	1021.59
14	1021.11
15	1022.67

CARR FORK LAKE
MOVEMENT MONUMENTS
151' DOWNSTREAM ℄
ROW 3
VERTICAL MOVEMENT

2


HORIZONTAL CUMULATIVE MOVEMENT
(HUNDREDS OF A FOOT)
-8
-7
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
LT. ABUT.
12+50
13+50
14+50
15
14
13
20 SEP 77
30 MAR 77
28 JUL 77
20 DEC 77
10 MAY 76
20 DEC 77
21 JUN 78
24 MAR 76
12 DEC 78
21 JUN 78
12 DEC 78
9 NOV 77
17 NOV 76
DOWNSTREAM



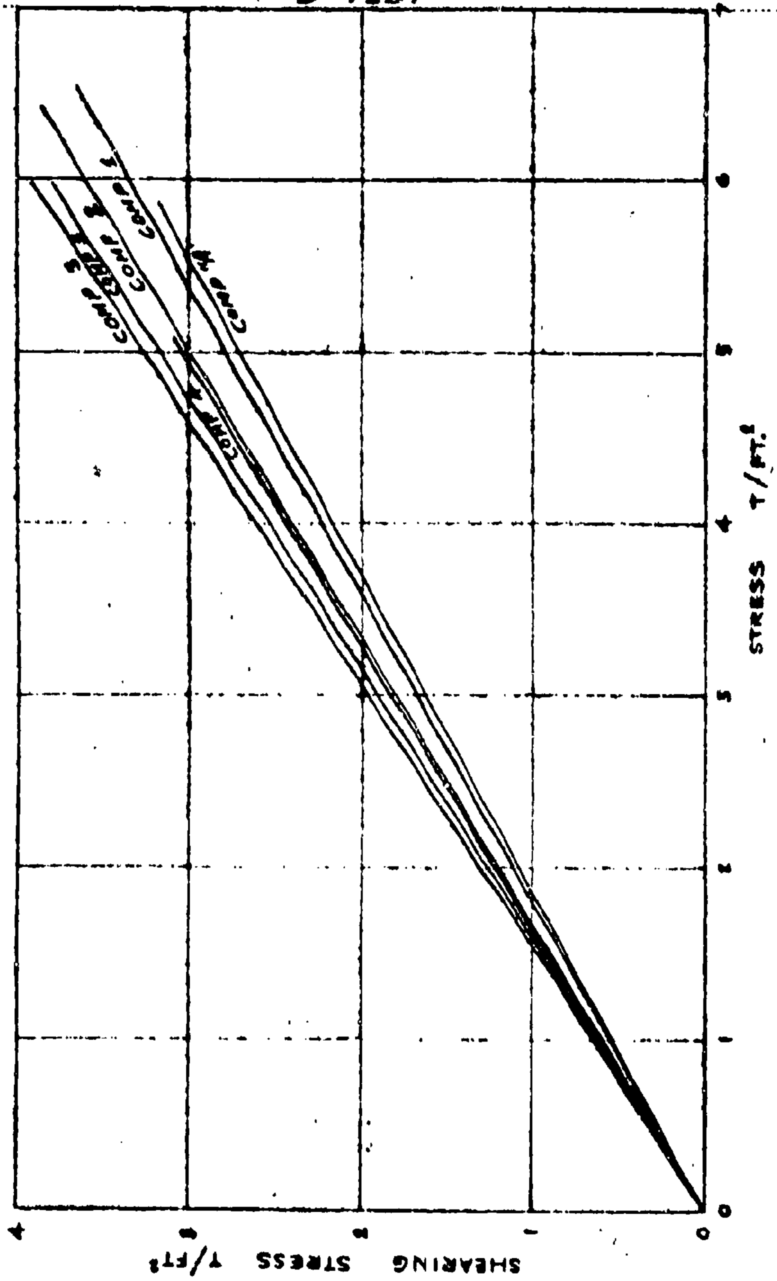
MONUMENTS INSTALLED 30 OCT 75
10 MAY 76
24 MAR 76
17 NOV 76
21 JUN 78
12 DEC 78
12
15+50
RT. ABUT.
MONUMENT NUMBER
STATION
-8
-7
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
CARR FORK LAKE
MOVEMENT MONUMENTS
151' DOWNSTREAM ℄
ROW 3
HORIZONTAL MOVEMENT

PLATE 2

BY .... DATE 10/8/[illegible] SUBJECT CARR FORK RESERVOIR .... SHEET NO. .... OF ....

CHKD BY .... DATE .... IMA EMBANKMENT SHEAR TEST SUMMARY JOB NO. ....

"S" TEST



HOLE NO.	SAMPLE NO.	CLASS.	LL	PL	TAN φ	C T/FT²	SATURATION
COMP #1	1&2	CL	32.8	21.8	0.568	0.00	
COMP #2	1&2	CL	29.0	18.8	0.593	0.00	
COMP #3	1&2	SM	N-P		0.640	0.00	
COMP #4	1	CL	28.7	20.1	0.600	0.00	
COMP #5	1	SM	N-P		0.626	0.00	
COMP A		CL	30.6	20.0	0.534	0.00	

Avg Value

Tan φ = 0.598

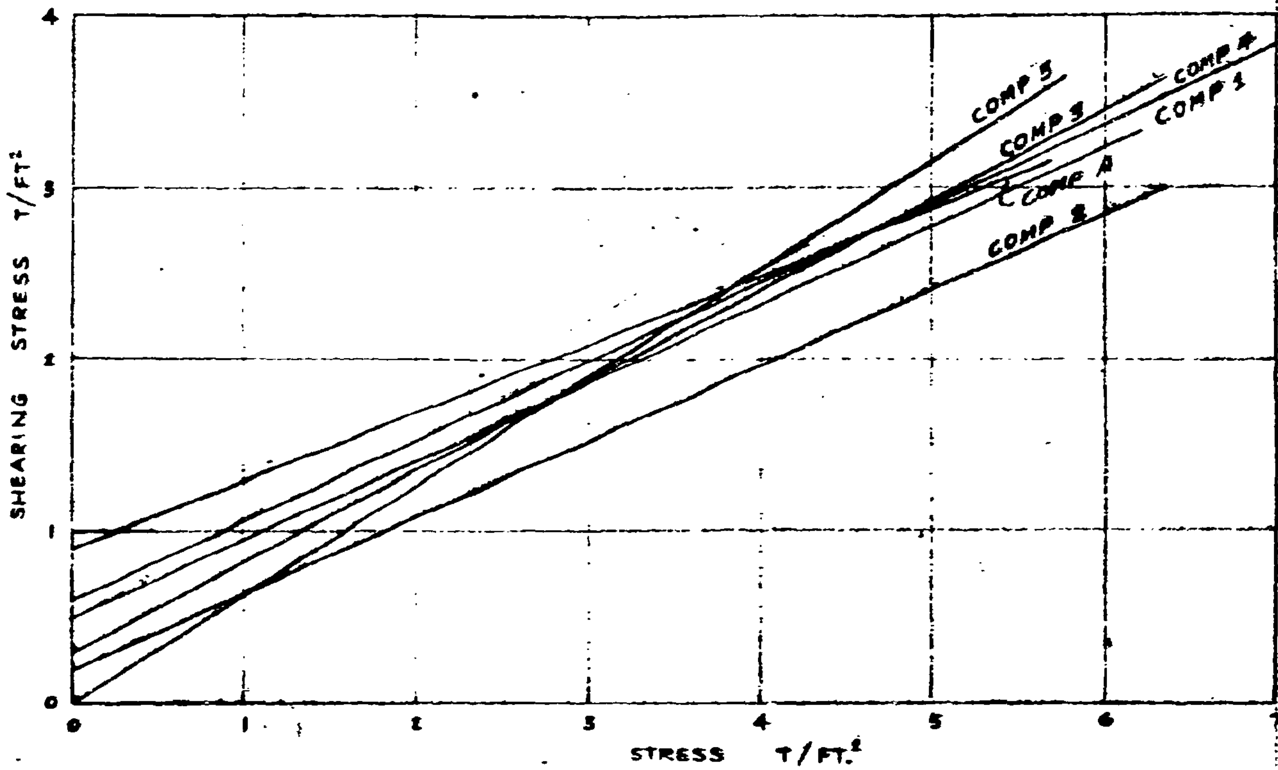
'C' = 0.00 T/ft²

PLATE 37

BY .... DATE 10/8/64 SUBJECT CARR FORK RESERVOIR .... SHEET NO. .... OF ....

CHKD BY .... DATE .... IMP EMBANKMENT SHEAR TEST SUMMARY .... JOB NO. ....

"R" TEST



AVG VALUE

Tan φ = 0.477

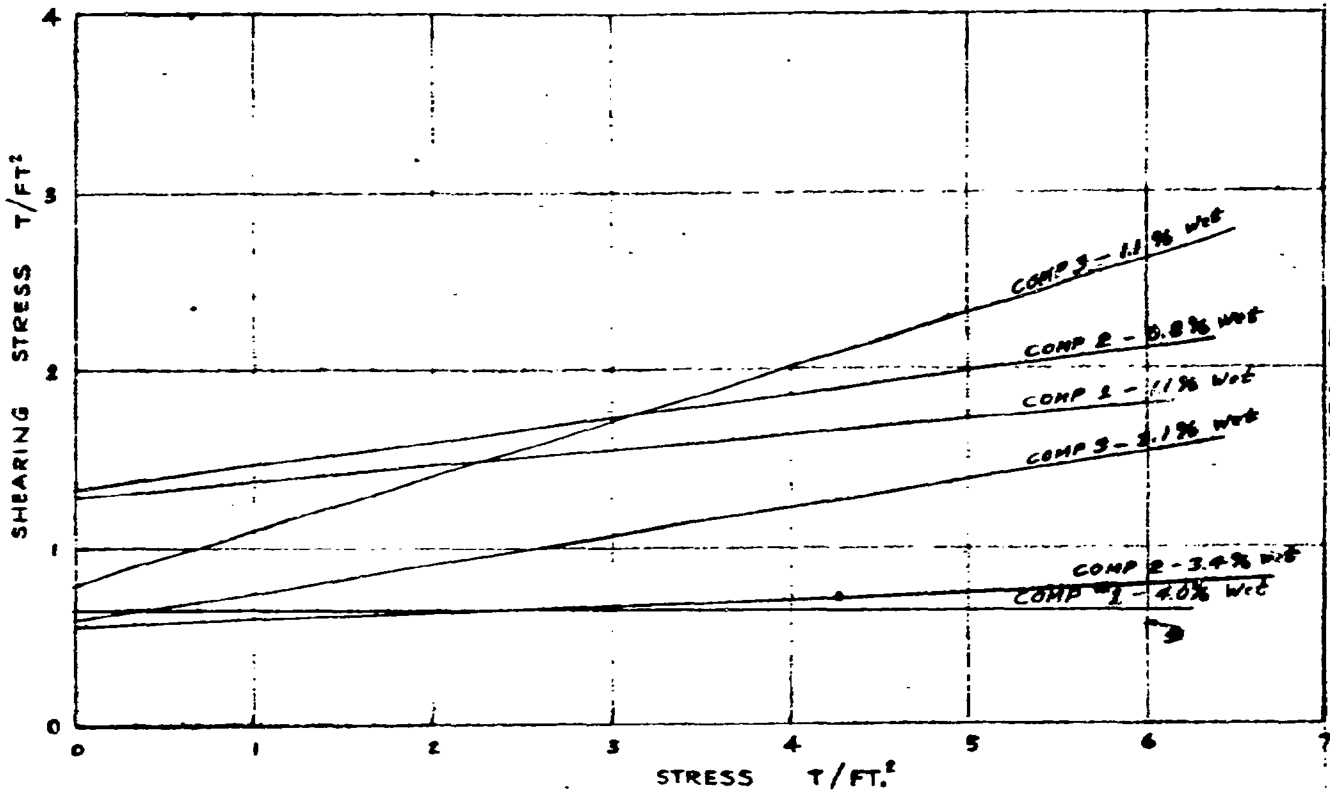
C = 0.42 T/Ft²

HOLE NO.	SAMPLE NO.	CLASS.	LL	PL	TAN φ	C T/FT²	SATURATION			
COMP #1	1 & 2	CL	32.8	21.8	0.410	0.55	114.5	106.3		109.3
COMP #2	1 & 2	CL	29.0	18.8	0.423	0.20	118.3	111.3		113.6
COMP #3	1 & 2	SM	N-P		0.518	0.30	110.4	109.1		108.4
COMP #4	1	CL	28.7	20.1	0.463	0.60	112.0	115.8		118.5
COMP #5	1	SM	N-P		0.630	0.00	111.2	112.7	112.9	107.4
COMP "A"		CL	30.6	20.0	0.410	0.90	118.4	121.8		121.7

PLATE 38

BY........ DATE 11/8/64 SUBJECT CARR FORK RESERVOIR SHEET NO. 1 OF 2
CHKD BY ...... DATE...... JHA EMBANKMENT SHEAR TEST DATA JOB NO..........

"Q" TEST



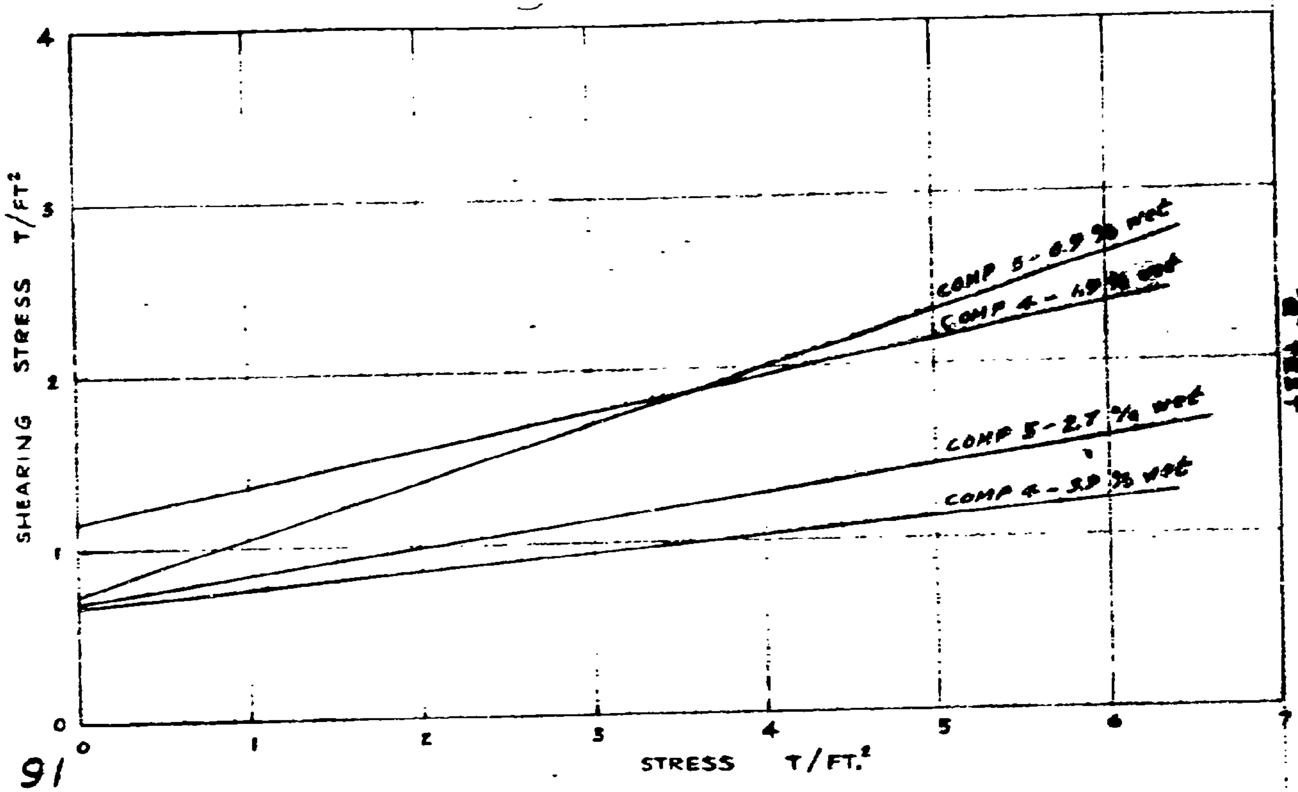
See Plate 91

HOLE NO.	SAMPLE NO.	CLASS.	LL	PL	TAN ϕ	C T/FT²	SATURATION
COMP #1	1 & 2	CL	32.8	21.8	0.088	1.30	1.1% wet of optimum
					0.000	0.65	4.0% wet
COMP #2	1 & 2	CL	29.0	18.8	0.143	1.33	0.8% wet of optimum
					0.036	0.56	3.4% wet
COMP #3	1 & 2	SM	N-P		0.306	0.80	1.1% wet of optimum
					0.156	0.60	3.1% wet

DATE 10/8/64 SUBJECT CARR FORK RESERVOIR SHEET NO. 2 OF 2

DATE 1MO EMBANKMENT SHEAR TEST DATA JOB NO.

"Q" TEST



See Plate 91

HOLE NO.	SAMPLE NO.	CLASS.	LL	PL	TAN φ	C T/FT²	SATURATION
COMP #4	1	CL	28.7	20.1	0.185	1.16	1.9 % wet of optimum
					0.102	0.67	3.9 % wet
COMP #5	1	SM	N-P		0.306	0.75	0.9 % wet of optimum
					0.140	0.70	2.7 % wet
COMP A		CL	30.6	20.0	0.160	1.50	2.5 % wet of optimum
					0.000	0.90	4.5 % wet

PLATE 40

DATE 10/8/64

CHKD. BY DATE

CARR FORK RESERVOIR
EMBANKMENT SHEAR TEST DATA
Q - STRENGTH SELECTION

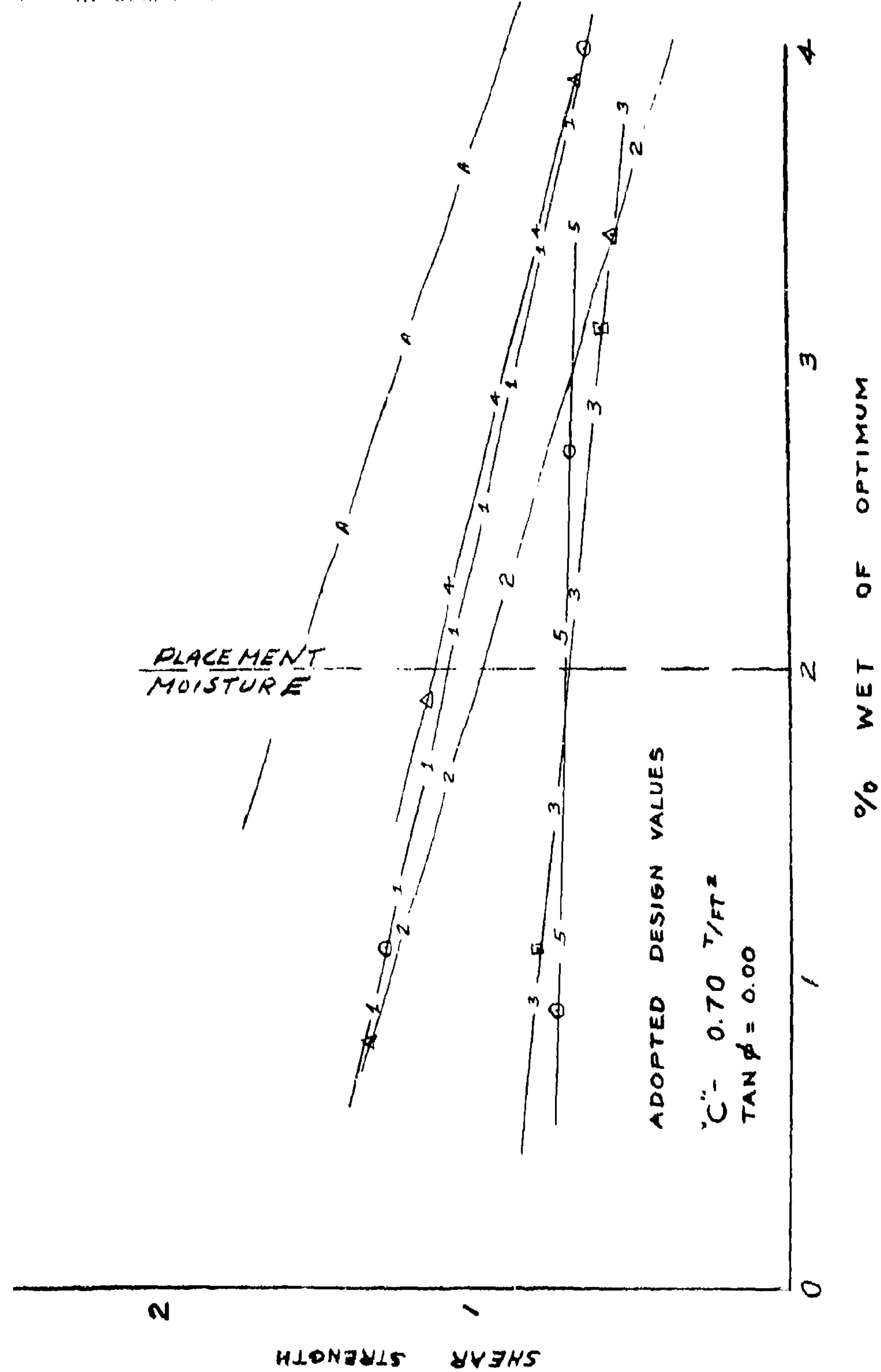
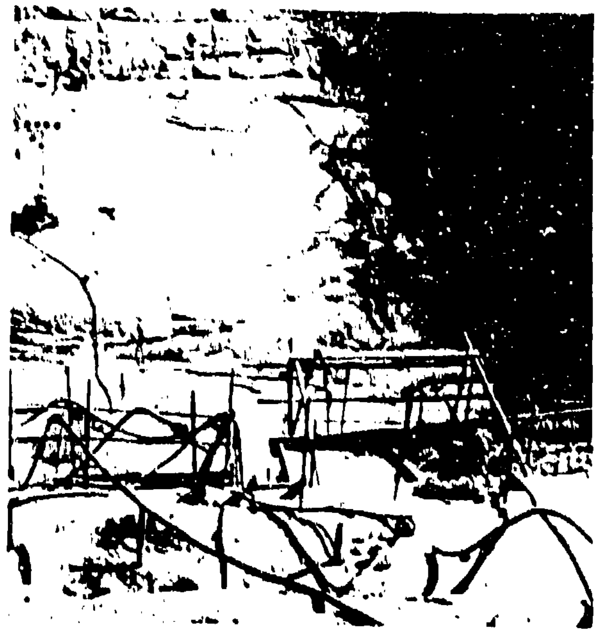


PLATE 41

Appendix I

(1)



21 October 1973
View from left abutment showing grouting on lower left abutment and cleaned core area across lowest area of dam.

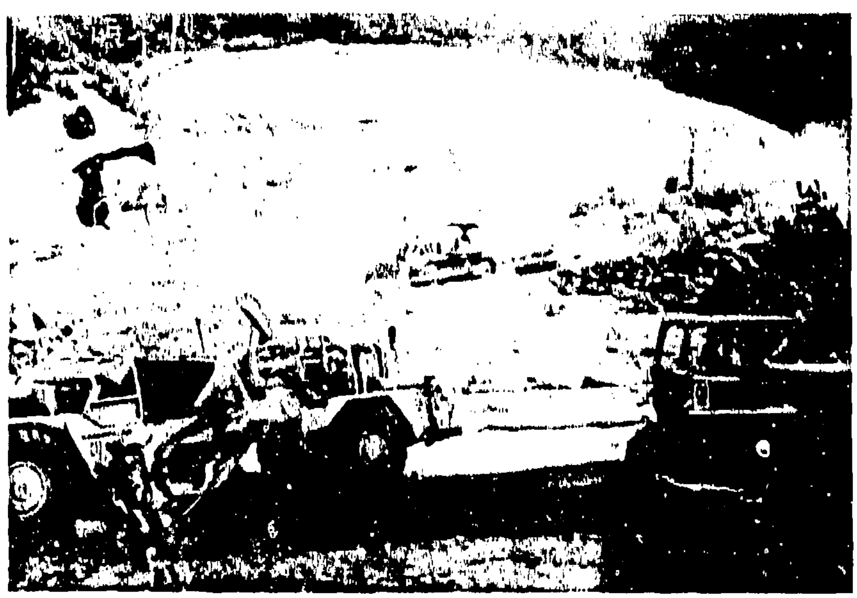
(2)

22 October 1973
Hand packing impervious core at embankment Station 13+05.

(3)

22 October 1973
View from lower left abutment showing grouting and initial placement of core material.

(4)



October 1973
View showing hauling and compaction equipment in use during the initial placement of impervious core in lower part of dam.

(5)

25 October 1973

Dental treatment of joints within special treatment area along the centerline of the right abutment. Impervious core and transition zones shown in lower area of dam.

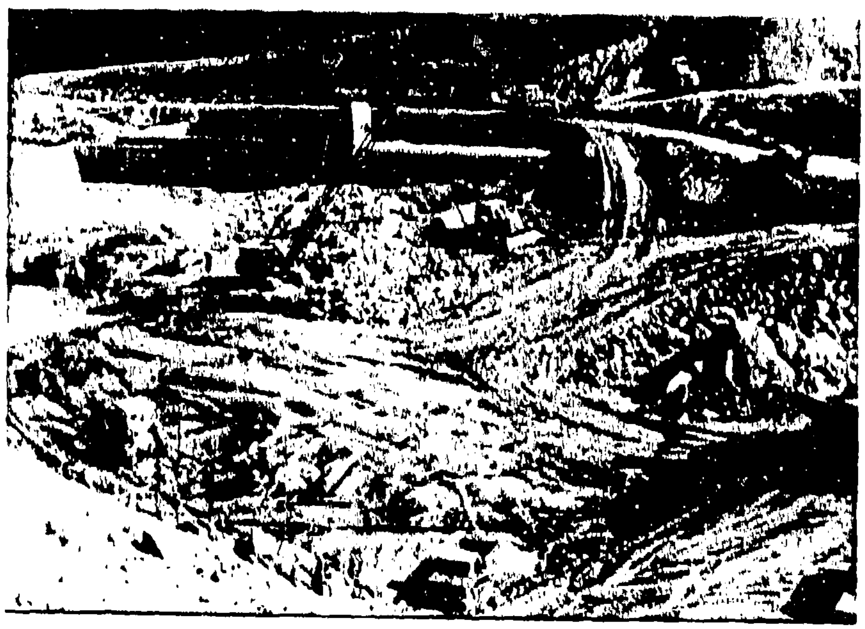
(6)

1 November 1973

A joint 0.3 foot wide infilled with silt station 14+75 cleaned out 1 foot deep and filled with dental concrete. View looking north across core area.

(7)

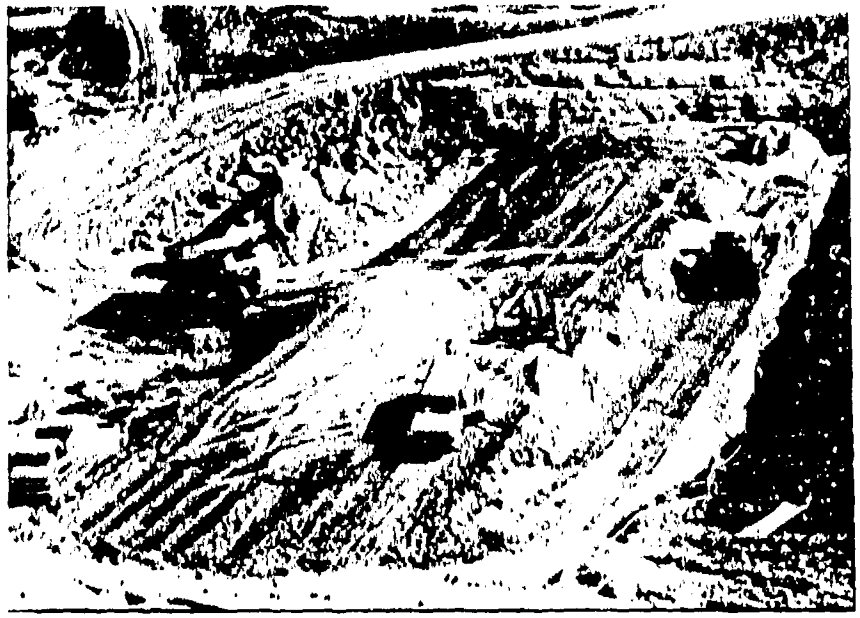
2 November 1973
View showing core rock tie-in on right abutment. Workmen hand cleaning right abutment Station 15+30 to Station 18+20 along Centerline of dam.



(8)

November 1973
View showing equipment used for cleanup of the D.S. area of the dam embankment.

(9)



November 1973
View showing impervious zone and filter aggregate being placed during initial placement of main dam embankment.

(10)

22 March 1974
View looking at left abutment of dam special treatment area from center of dam embankment.

(11)

22 March 1974
View of right abutment of dam from west edge of spillway. No embankment placement this past winter. Bottom of picture shows graded aggregate stockpiled on top of permanent cofferdam, elev. 1010.

(12)

8 July 1974
Looking from left abutment toward to right abutment. Center of picture is dental treatment at Station 17+70, centerline of dam.

(13)

8 July 1974
View from right abutment toward left abutment. Impervious core, graded aggregate and shale zones shown. Spillway cut upper left of photo.

(14)

21 August 1974
View showing upstream face of dam, riprap and haul road ramps. Bench upstream is at elev. 1010.

(15)

21 August 1974
View from left abutment showing upstream face of dam and haul ramps onto embankment. Upstream bench is at elevation 1010.